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NOTES DURING A JOURNEY IN GUATEMALA, MARCH TO DECEMBER, 1902.

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INTRODUCTORY.

The following notes are based upon two visits to Guatemala. The first was made in 1880 and 1881, and lasted about one year. During this time I explored, principally on foot, the northeastern, eastern, and southern parts of the Republic. My second journey was due to a special mission intrusted to me by Mrs. Ph. A. Hearst, and lasted from March to December, 1902. During this time I visited principally the western and southern part of the country. The considerable interval between my two journeys has enabled me to note many changes which have taken place as regards biological, botanical, zoological, as well as agricultural aspects—changes which must greatly be regretted by every lover of the matchless nature which Guatemala shares with the rest of Central America. It has been frequently presumed that the luxuriant nature of a tropical country would rapidly heal the wounds inflicted by man's thoughtlessness, and that an abundance of rain and sunshine would soon

replace the devastated forests, as well as re-animate them with birds and other animal life; but a careful study shows that this is not the case. In the tropics, as well as outside of these regions, the rule seems to be that nature is slow in healing the wounds inflicted by the methods which man commands, and that, here as elsewhere, what is once gone is gone forever. During the last twenty years the whole aspect of the coast region of Guatemala has completely changed. The former forests have given place to plantations. In many places these have been since deserted; but the tropical forests have not returned, and many of their former inhabitants have become extinct. Where once deep soil covered the rock, the destruction of the trees has been followed by the washing away of the soil and the laying bare of the bed-rock, just as in our own country. As a personal narrative would occupy too much space, I have here simply condensed some notes of more general interest.

The Pacific Shore-line, its Aspects, Rainfall and other Climatic Conditions.

Travelling from San Francisco, California, along the Pacific coast of the continent to Central America we pass through three distinct climatic zones. The "extra-tropical arid zone" characterises Alta and Baja California, as far down the coast as the Cape Region of the latter country. The "tropical arid zone" begins with the Cape Region of Baja California and continues as far down as the town of San Benito, near the boundary of Guatemala. The "moist tropical zone" again begins in the vicinity of San Benito, and continues southwards below the equatorial region of South America. These three zones are quite distinct one from the other, though at the points of contact the transitions are somewhat gradual.

The "extra-tropical arid zone" is characterized by dry summers, during which dense and cold fogs are only too frequent even some little distance inland from the coast. The winters, again, are rainy, as a rule without any fogs, but with heavy frosts, especially in the interior valleys back of the coast. These winter rains, which all originate from *lows* in the Pacific Ocean off the coast of Alaska and British Columbia, diminish in intensity as we go farther south. While they never fail in California proper or Alta California, they become very scant and irregular along the coast of Baja California. As far down as San Quentin these rains seldom fail, but south of that point they become scarcer and lighter, until at Magdalena Bay they occur only once in three or four years. A characteristic of these rains of the extra-tropical arid zone is that

they are rarely accompanied by thunder and lightning, and may consequently be termed gentle rains, the word applying both to the quantity of the rain and to the force with which it descends.

South of San Quentin begins a short transition zone towards the tropical arid zone. As the winter rains become scarcer the tropical rains of the next zone become more frequent during the summer months—June to November. They do not occur, however, yearly, but at intervals of from one to three or more years. But as we near the Cape Region these tropical rains become more frequent, and from the vicinity of Todos Santos south of Magdalena Bay they may be considered as of yearly occurrence.

The "tropical arid zone" may be said to be fully characterized at the northern boundary of the Cape Region, though even here the influence of the northern winters makes itself felt at rare intervals. This influence manifests itself in the shape of occasional fogs, and in gentle rains, during December and January. In the vicinity of San José del Cabo such rains and fogs occur at intervals of one to several years. As a rule, the tropical arid region of the Pacific coast is characterized by rainy summers, the rain beginning in June and lasting to November. But even in this zone the change is gradual and irregular. While north of the Cabo San Lucas the rains on the Gulf coast begin frequently as early as the middle of June, they may in the vicinity of San José del Cabo seldom be looked for before September. However, as we enter the Mexican mainland on the Pacific, the summer rains become more frequent, as well as heavier. From Mazatlan southwards the months of June to October can always be counted on as rainy, though even here the rains are irregular and capricious. As we go south, in this zone, the rainfall increases in quantity as the season lengthens, but this increase in quantity and in time is much less marked than in the extra-tropical arid zone. This feature of homogeneity in the distribution of the rainfall in this zone is undoubtedly due to the physico-geographical features of the coast and the land back of it. We must remember that, while the rains of the extra-tropical arid zone originate in the Alaskan region, those of the tropical arid zone come from the evaporations and *lows* in the Gulf of Mexico. This solitary influence of the Gulf of Mexico extends as far as the southern boundary of the Gulf of Tehuantepec or the isthmus of the same name. South of this point precipitation is influenced by two sources of *lows*—one in the Gulf of Mexico, the other in the Caribbean Sea.

To this difference in the precipitation of rain, both as regards quantity and time, along the Pacific coast, is due the characteristic

appearance of the coast-line. Along the coast of California the forests rarely descend to the shore-line. This is especially the case south of Point Conception. The shore hills are here mostly bare or sparsely wooded with oaks; while upon the higher ridges may be seen pine and other conifers. During the rainless months—May–November—this coast presents to the traveller an uninterrupted waste of yellow rounded hills, only here and there dotted with darker live-oaks. As we approach the boundaries of Baja California even this remnant of evergreen trees and shrubs becomes scarcer, until at last south of San Diego they entirely cease. Along the coast of Baja California we look in vain for any traces of shore forests. Seen from the ocean the coast appears extremely barren, and only here and there do we find at the mouths of cañons clumps of cottonwoods, or mesquite trees. An exception to this so very barren aspect of the shore-line is seen on the island of Cedros, where the higher ridges near the shore are covered with pines.

As we enter the tropical arid region the shore aspect becomes less forbidding. At San José del Cabo a fringe of cocoa palms marks the shore; while during the rainy seasons the hills near and far are covered with a dense verdure, resulting from innumerable species of acacia-like shrubs and trees.

South of Mazatlan we meet, for the first time, with denser forests along the ocean shore. The part nearest the water's edge is always occupied by a thin belt of palms, principally cocoa and cocoayol palms. Behind this belt we find here and there, especially where the soil is of an alluvial nature, more or less broad belts of tropical forest of evergreen dicotyledonous trees. But in all this Mexican region the hills immediately above the coast-line are comparatively bare of evergreens, and principally covered with shrubs and small trees with deciduous leaves.

From the northern part almost of Baja California to the vicinity of San Benito, near the Guatemala boundary, the traveller beholds a backbone ridge—a sierra—with sharp peaks of generally fantastic shapes. These are bare of trees, but prominent on account of their rocky nature, which the seasonal rains have never been able to cover with an evergreen vegetation. This is the general aspect of the country as far down as the Isthmus of Tehuantepec. In the vicinity of the isthmus the interior sierra has dwindled to low rounded hills, while the immediate coast-line has preserved its barren aspect, due to irregular and not overabundant rains. But at San Benito we suddenly perceive a great change. The barren rocks, formerly so common and so monotonous, disappear entirely, giving place to an

evergreen tropical vegetation of shrubs and forests. The continuous belt of cocoa palms along the shore gives place to mangrove swamp-plants, of low height, the palms retreating to the higher inland hills. The fantastic peaks of an interior sierra have been replaced by an immense cordillera so densely covered with vegetation that not a bare rock or stone can be seen anywhere. From this general cordillera there rises, at certain measured intervals, a succession of volcanic cones of surpassing beauty and grandeur.

Climatic Conditions of Guatemala.

Guatemala is situated between 13° 42′ and 17° 48′ lat. N., and 88° 10′ and 92° 30′ lon. W. Greenwich. While this situation determines the general climatological conditions of Guatemala, it does neither account for the climatic peculiarities of the country as compared with those of the adjoining countries, nor for the differences in climatic conditions of the various parts of the Republic itself. The main factors which regulate these conditions are the height and extent of the mountain regions. By far the greater part of Guatemala consists of an elevated mountain-complex, which is further subdivided into a complex system of mountain ridges separated by more or less elevated valleys. It is to be regretted that this country, as well as the rest of Central America and Mexico, has never been properly surveyed, and that the existing maps are in many respects incorrect. As regards meteorological records, the case is aggravated by the carelessness of the observers of the few existing stations and the absence of scientific interest with which their observations have been made. The scarcity of the stations is such that it is at present impossible to form any correct idea of the origin and movements of the *lows*, upon which the general rainfall is dependent. The main feature which distinguishes Central America from Mexico is that the former country receives its rainfall from two distinct sources at the same time—*lows* originating both over the Pacific Ocean and over the Caribbean Sea. This insures a much greater and more evenly distributed rainfall to Central America than to Mexico. This is the principal difference between the two countries. The differences depending upon changes in temperature are slighter, as both countries are elevated and, as regards their interior tablelands, often visited by heavy frosts, which in the highest places are of great continuity and often intense. The main climatic factors are, then, the humidity of the air, the temperature and the rainfall, each of which will now be considered more in detail.

Humidity of the Air.

As might be expected in a country situated between two tropical oceans, the humidity of the air in Guatemala is very great. There are, however, considerable differences in different localities. As a rule, it may be said that in the mountain region and in the low coast-belt the humidity of the air approaches a more perfect saturation than in the interior valleys. The northern mountain region is much more humid than the southern, and the Atlantic coast is much more moist than the Pacific. On the Pacific side the saturated air-belt stretches along the whole coast from San Benito, in Mexico, far south towards the equator. In width this moist belt extends from the Pacific shore-line for about thirty to forty miles inland to a line which runs more or less parallel with the shore, following the crest of the volcanic fissure along which are situated the volcanic peaks. On the Atlantic side, as well as on the northern border, this moist belt is broader. The ascent of the land from the coast is on that side more gradual, and the mountains, as a rule, are less elevated. The moist belt-line is on that side more irregular and ends less abruptly than on the Pacific side. Roughly speaking, a line running east and west passing through Huehuetenango, Salamá, and Zacápa divides the extremely moist zone from the one less moist. To the north of this line we have the high mountain-complex, in which all the largest rivers in Guatemala and Mexico have their head-waters; while to the south of that line we meet with interior valleys more or less surrounded by high mountains, and which are characterized by a comparatively low humidity of the air. Going from west to east, this humidity of the air decreases, as is clearly seen if the valleys of Huehuetenango, Quiché, and Salamá are compared. This is due to the fact that the valley of the Rio Grande or Motagua, which runs from west to east, is much lower than any of the other inland valleys, the moisture thus having been precipitated on the surrounding high mountains before it reaches the basin below. The decrease of moisture is so great that the basin of Salamá and a great part of the Motagua basin partake to a considerable extent of the nature of a desert region in which crops require to be irrigated by artificial means.

The interior tablelands, extending from the coast cordillera on the Pacific side to the high mountain complex mentioned above, enjoy a comparatively moist air both in winter and summer, the moisture, however, being less than in the belt surrounding them.

But even within a territory in which we might expect an even distribution there are found great differences, difficult to account

for. These will be further considered in connection with the botanical zones; here we will only state that everywhere the humidity of the air is much greater in the forests than in the open country. This may be readily observed in places where the formerly impenetrable forests have been cut down in order to leave room for plantations. But even in places where no such destruction has taken place we meet with vast areas in which the humidity of the air falls so low as to become insufficient for the wellbeing of most so-called tropical plants. This is especially marked in the regions of the savannas, in the highest part of the cordillera and the northern sierra, and in the valleys of Salamá. According to statistics furnished by the Laboratorio Químico Central in Guatemala, the greatest saturation takes place just before sunrise. In Guatemala City the average humidity at that hour throughout the year is 89%; while at noon it is 69%, and at 9 P.M. 87%. In Alta Verapaz, at nearly the same altitude (4,883 ft.), these numbers would be respectively 95%, 72%, and 86%.

Rainfall.

The abundance of the rainfall in Guatemala is, as has already been stated, due to *lows* on either side of the continent. In the zone situated north of the Huehuetenango and Zacápa line the precipitation takes place principally during northeast winds; while south of this line the rains are generally precipitated during southern winds. It is thus evident that we have here to deal with two systems of *lows*—one originating in the Pacific and the other in the gulfs of the Atlantic Ocean.

We can, in Guatemala, distinguish between three more or less distinct zones of precipitation; but, as a rule, it may be said that the rainy season lasts between the months April and November, the months from December to March being those in which the least rains fall. The first of these zones of precipitation is situated north and east of the Huehuetenango-Zacápa line, including the high northern sierra complex, with the Cobán region as well as the Atlantic slope. In this zone the rains are less confined within certain seasons. The rainiest months are those between April and November, but rain may be, and generally is, precipitated during every month in the year. Especially is this the case in the highest part of the sierra region and along its northern slopes—that is, the headwater-zone of the large rivers Usumacinta and Chiápas, Rio Polochíc, and Cáhabón. In the zone of the Rio Chiápas daily fogs are the rule. These fogs degenerate into rain, which, while

sometimes gentle, generally finishes in tremendous downpours. The rain precipitation in this zone has never been accurately measured, but it is safe to say that it is by far the greatest in Guatemala, and that it reaches 6,000 millimetres or more (240 in.). In the eastern part of this large northern rainbelt the rainfall averages between 3,000 to 4,000 millimetres (120–160 inches), being less in the valleys of Rio Cáhabón than in the surrounding mountains.

The second zone of precipitation is situated south of the line Huehuetenango-Zacápa, and extends to the volcanic cordillera, which runs parallel with the Pacific coast. It occupies the whole of the large interior tableland of Guatemala, the principal part of the district being the valleys tributary to the Rio Grande or the Motagua. Of this zone the northeastern part is the driest, this part including the valley of Salamá, a tributary of the Usumacinta. Here the moisture and rainfall are especially scant at any time of the year, and a month or two may pass in the middle of the rainy season without any precipitation. The explanation is that the moisture in the air, carried to these interior valleys by northern winds, has already been precipitated on the northern slope of the surrounding sierra. The change from the dry plains around Salamá to the moist ones of Cobán is most marked and interesting. Ascending from Salamá the high mountain crest which separates the two places, the traveller has to pass for ten leagues over comparatively barren hills, on which not even drinking water is found during the dry season. But upon arriving across the range he finds himself, without any warning, in a paradise of freshness, where every acre of the ground is watered by springs, and where the soil is clothed with eternal verdure.

The valley of the Rio Grande is especially dry and inhospitable to vegetation, resembling, during the dry season of the year, the barren hills of the Mexican Pacific shore. As we proceed towards Guatemala City the rainfall increases, and the aspect of the vegetation is less barren. It is to be remarked that in all this interior zone the mountains are more favoured with precipitation than the valleys. A few hundred or a thousand feet may make considerable difference in the rainfall of the respective localities. The amount of rainfall in this zone varies considerably. In Guatemala City the precipitation averages 1,500 millimetres (60 in.). In Salamá it averages 600 millimetres (24 in.); in Quezaltenango, on the eastern border of the zone, it is somewhat more than in Salamá, or about 700 millimetres (28 in.). In this interior zone the dry season is well and clearly separated from the rainy one. The rains seldom

begin in earnest before May, and they generally finish in October. The months from October to April may be counted as dry, though exceptions may occur. The precipitations in this zone are, however, far from continuous or of daily occurrence. In the beginning of the rainy season we may expect a shower every afternoon for some days in succession; then several days may pass in which there is no rain. A more prolonged spell of continuous dry weather is regularly experienced in the middle of August, when, according to expectation, no rain falls for two weeks. The year of my first visit this dry period occupied fifteen days; while during my recent journey no rain fell for five weeks.

In this zone the first rains are expected at the end of April or the beginning of May. The popular idea is that it always rains in the City of Guatemala on the 4th of May, but, like all other popular beliefs, this one is not to be relied upon; statistics show that rains commence in April as often as in May. The first showers are generally, if not always, accompanied by thunder and lightning. For weeks previous the sky is generally overcast with apparent thunder-clouds during the middle of the day, though no precipitation results. Later on, the mornings are clear and bright; but at noon clouds are seen gathering in the south, and between 1 P.M. and 2 P.M. a thundershower may be expected.

This is repeated, on an average, about fifteen times during each of the months June, July and September, with a perceptible falling off in August. In October and November the thundershowers are rare, the rains then being of a drizzly nature, like those on the coast of California. At the end of the rainy season the sky does not clear at once, but remains cloudy for days, or even for several weeks, after precipitation has ceased. But instead of clouding up only in the middle of the day, we find that at this period already the mornings are cloudy, while the middle of the day is clear.

In this zone, as well as in the two other zones, the precipitation takes place during the height of the rainy season twice a day. As stated, the first showers commence rather regularly between 1 P.M. and 2 P.M , lasting up to one or two hours, or less. In the evening, between 7 P.M. and 9 P.M., another rain may be expected of from one to several hours' duration. In this zone, as well as in the two other zones, rain in the morning and forenoon is of extremely rare occurrence, and the traveller can nearly always count upon fair weather from 4 A.M. to 12 noon in any part of Guatemala.

The third zone of precipitation extends from the Gulf of Tehuantepec along the coast of Guatemala past its southern boundaries.

This zone is characterized by a much greater amount of rainfall than the interior zone, but by a lesser one than the northern zone. In this coast region we may also distinguish two seasons—one dry and one wet. The dry season occupies the months of December to April, the wet one the remainder of the year. Nearly the whole of the precipitation comes in the nature of thundershowers, gentle rains being of rare occurrence. The rain always comes with southern winds, and with accumulation of clouds along the crest of the coast cordillera. It is heavier along the slopes of the cordillera than farther down along the coast. The quantity may be considered as somewhere near 4,000 millimetres (160 in.). The rainy season begins about the same time as in the interior, or in March to May, but it lasts about a month longer than in the interior. The rains are generally accompanied by heavy winds, which, during the height of the season, are of great force, but of short duration.

There are two periods of precipitation daily—one between 1 P.M. and 8 P.M., the other from 8 P.M. to 9 P.M. A third period is often in the morning hours, between 2 A.M. and 4 A.M. Between these periods of daily precipitation the sky clears along the lowlands, though along the crest of the cordillera the volcanic peaks are nearly always obscured, except from 6 A.M. to 8 A.M., when they may be clearly seen. The rainfall diminishes towards the southeast to such an extent that there is probably a difference of about 1,000 millimetres (40 in.) between that of the boundary line of Mexico and that of Salvador, the main cause being, probably, the diminished height of the cordillera towards the southeast. The greater rainfall in the region known as the Costa Cuca may also be due to the fact that this part receives also precipitation from *lows* originating in the Gulf of Mexico, but rarely extending south of the point of San José.

Temperature.

There are two maxima and two minima annually, according to the position of the sun. The maxima occur in April–May and August, and the minima in July and December–January. The maximum in July is tempered by the cloudy skies and the rainy spells of the winter months, while the minimum in January is moderated by the dry air and the constant sunshine during that time. The daily fluctuation of temperature shows that the lowest point is reached at sunrise, while the highest is registered at about 2 P.M.

The mean temperature in the City of Guatemala is, indoors, 74° Fahr., while out-of-doors it is 66°. In the sun it seldom reaches 86°. From sporadic observations made by travellers and a few per-

manent settlers it is supposed that the mean temperature of Salamá is 74°; that of Quezaltenango, 58°; that of Port Barrios, 78°.

The frost-line of the Pacific slope coincides with a line passing along the crest of the cordillera at an altitude of about 4,000 feet. This is also the altitude of the base-line upon which rest the pyramidal cones of the volcanoes and the passes situated between them. On the coast side of these passes and below them frosts are unknown, but slightly interior to the passes frosts occur at rare intervals, increasing in frequency with the altitude. The frost-line marks the limit for the cultivation of the coffee tree, and, to some extent, for the profitable production of sugar-cane. But it is interesting to note that the best coffee, as well as the best sugar, is produced close to the frost-line, such coffee and sugar being more highly flavoured than that grown in the warmer lowlands.

The practical experience as regards the wellbeing of man in Guatemala is that, except for the narrow coast-belt, the temperature is comfortable and agreeable, and, as regards sensation, almost ideal, both winter and summer.

Electric Storms and Circular Lightnings.

Thunderstorms are characteristic of all parts of Guatemala, but especially so of the Pacific coast along the cordillera and in the highlands of Alta Verapaz. In the high mountainous complex of the Departments of Huehuetenango and Quiché they are comparatively rare, though along the interior valleys they are more frequent. During a journey from Chaculá, on the Mexican border, to Aguacatán, I was told everywhere that thunderstorms were rare. During my stay there we had no thunderstorms, though heavy rains were of daily occurrence. During the months of November to January electrical storms are rare, though they do occur. During this time the sky is generally clear during the early part of the day, and magnificent distant views may be had, which is not the case during the months from April to October.

The intensity and frequence of the lightning flashes during the height of the rainy season are something extraordinary. During a single evening, while travelling from San Juan Sacatepeque to the City of Guatemala, I counted more than one thousand lightnings from a single group of clouds in the direction of Tecuamburro, which locality seemed especially favourable to these phenomena, repeated almost every day for nearly a month (September).

Almost every traveller in tropical Central America has described what is known as "circular lightning." These lightnings occur

generally at the end of the rainy season, and are more frequent on the coast than in the interior. It has been supposed that they are due to a certain quality of electricity, differing in intensity from the ordinary. The observer sees no rays, but simply a disk-like flash in a cloud, with a perfect absence of electric streamers. During my stay in Guatemala I had frequent opportunity to observe this interesting phenomenon, and I think the explanation is not a difficult one. I am satisfied that there is no difference in quality nor in quantity in the electricity of the two kinds of lightning, but that the cause is the character of the clouds. While in countries outside of the tropics thunderclouds occupy, as a rule, a single stratum in the air, in Guatemala and other parts of Central America it is not unusual to find two, or even three, distinct strata of cumuli, one above the other. When electricity is discharged from clouds arranged in a single stratum, the discharge takes place either between the clouds and the earth or between two clouds approaching each other. The same may, of course, be the case when we have two strata of cumuli, one above the other. But sometimes this is not the case, and, when three strata of cumuli are superposed, regular electric streamers are rarely observed. Instead of discharging to the earth the discharge takes place between the respective strata exactly in the same manner as usual; but the fact that we then frequently see the discharges in the direction of their longitudinal axis prevents us from observing the streamers. For instance, the discharge takes place between two clouds, one above the other, the two being shielded from our view by a third lower one. We then see, not lightning streamers, but simply a single flash, which is reflected by the cloud-banks immediately surrounding it. During my night trip just referred to I had ample opportunity to observe this phenomenon, and out of the one thousand or more flashes observed, at least six hundred belonged to the circular class. Whenever there was a rift in the cloud-banks and the discharge was oblique to the axis of view the streamers were distinctly visible. Many times there were observed as many as three distinct electric discharges at the same moment. The central lightning, being hidden by a cloud, was then often circular, while the side flashes were seen to be streamers of the most pronounced nature. These, my first observations, were confirmed by many others, and I satisfied myself that circular lightning is simply an electric discharge between two or more small cumuli superposed on each other, the point of observation always being in the direction of the axis of discharge. Thus, what will appear

as a circular lightning to an observer placed in the extended axis of discharge, will appear as stream lightning to any one who sees the same discharge from a point of view outside of the prolongation of the above axis, and when both clouds are distinctly in view. Such circular lightnings have not been known to strike the earth, as the discharge is intercepted by the lower stratum of cumuli. Whenever the lower stratum of cumuli is continuous, all the flashes appear as circular or disk lightnings, but where breaks occur in the low stratum the lateral streamers become visible as such.

Vegetation Zones.

With a few exceptions, all the soil in Guatemala is covered by vegetation. In some localities this vegetation is scant and of an arid aspect, but, as a rule, it is of a tropically luxuriant nature. As in most countries which rise abruptly from the ocean, and which, besides, are characterized by immense interior highlands, zones of vegetation are well defined and highly characteristic. The student of geographical and physical botany has in Guatemala a wide and interesting field, as in few countries are there to be found such a variety of extensive vegetable zones. As elsewhere, these zones are determined by temperature, humidity, altitude, and exposure to winds. While these zones are scientifically very interesting, they are also of great economical importance, and the horticulturist must take them into consideration if he hopes to succeed in making profitable investment. Each one of these zones of vegetation is also favourable or unsuitable to certain economic plants, both native and imported ones, and the prosperity of the country is thus dependent upon a proper understanding of the nature and extent of the different zones.

The general opinion of those who are not acquainted with the tropics of Central America is that the country is intensely hot and moist, and more or less unfit for one born in northern or more temperate latitudes. As regards Guatemala this opinion is especially erroneous. With the exception of a comparatively narrow strip along the two oceans the Guatemala climate is temperate, and tropical only as regards absence of extremes of temperature. Considering only the larger and more strikingly distinct zones, we may limit them to two—the great littoral region along the shore of the Atlantic and the Pacific oceans and the great interior highlands. If we count in the almost unpopulated or rather uncultivated region occupied by the territory or Department of Petén—which, of course, is not littoral—the former region occupies about one-half of the

whole Republic. This half may be considered as warm and moist, with no great distinction between a dry and a rainy season. The other region, comprising the tablelands, is characterized as dryer and more temperate, with a distinct division into a dry and moist season. But upon a closer examination we find that this general section is not strictly correct, though it gives a rough general idea of the nature of the country. As the nature of the vegetation zones depends upon three or four different factors, it becomes evident that, according to the various combinations of these factors, the result must be several distinct zones of vegetation. These we will now consider somewhat more in detail.

The Littoral Saline Zone.

This zone occupies the fringe of the Pacific shore and, to some extent, that of the Atlantic side, wherever the shore is low and covered with larger and smaller *esteros* or lagunes with salt or brackish water. Another name for this region is "mangrove swamps," though the vegetation is not alone confined to mangrove plants. This zone is very narrow, seldom more than a few miles in extent, and of varying length according to the height of the land above the high-water mark. Where the swamps are broken through by elevated or rocky projections the mangroves are replaced by tropically dense forests similar to those of the next zone. Such, for instance, is the case at the southern extremity of Guatemala near the boundary line of Salvador. The vegetation of the mangrove zone consists of evergreen shrubs or low trees, rarely over twenty feet in height. These thickets are always so dense that they may be considered impenetrable, except where canoes pass along the open channels of the *esteros*. This zone is unsuited to cultivation, except in places where the land rises above the saline swamps. In such localities cocoa palms and other tropical plants may be cultivated to a limited extent. This region is feared on account of the fevers; but the knowledge that the cause lies with the mosquitoes does not seem to have reached those who should be most interested in knowing it.

The Humid and Warm Arboreal Zone.

Wherever the saline esteros give place to higher lands we meet with impenetrable forests of majestic tropical trees. In Guatemala this zone occupies the littoral of the Pacific, the littoral of the Atlantic, the Bay of Honduras, the northern slope of the northern sierra complex occupying the Departments of Huehuetenango and

Alta Verapaz, and also the larger part of the immense territory of Petén. These originally impenetrable forests extend in some places from the waters of the ocean to an altitude of over 10,000 feet on the slope of the Pacific coast cordillera. On the northern slope of the northern sierra these forests gradually merge into those of the next zone; but I incline to think that they do not reach as high an altitude as on the Pacific side. The forests in this zone are composed of dicotyledonous trees of tropical genera and species in great variety. The trees are evergreens, and many are of great height. The most prominent trees of this zone are the *ceiba*, in many species, and the gigantic figtrees or *higuerones*. The ceiba must be considered as the largest tree in Central America, not perhaps as regards height, but certainly when bulk is considered. The forests in which these trees grow are characterized by their density, due not alone to the undergrowth of smaller plants and the close proximity of the large trees, but principally to the impenetrable growth of parasitic plants of various nature. With a few exceptions, every tree is a botanical garden in itself, covered with climbing aroids, with morning-glories (*Ipomea*), with ferns and orchids. The exception to this is found in a very few tall and slender trees which shed their bark annually. On such trees the climbers do not get a hold, but are shed with the bark of the tree. The most remarkable tree of this nature is called the *Tumbador*, with leaves like a papilionaceous plant, to which family it probably belongs. The stem of the tree is slender, without branches except at the top, and the bark is smooth and white—a striking exception among trees which are covered from top to root with a dense network of climbers, often to such an extent that only the very crown of the tree is visible.

The form of the trees in this zone is generally uniform. A tall, slender and erect trunk, free from branches; at the top of the trunk a large, broad umbrella-shaped crown, with powerful but elegant branches spreading evenly in all directions. The trees are commonly furnished with buttresses, which support the trunk and prevent it from toppling over or bending. The tall and unbranched trunk gives the minimum lodging to parasites, while the umbrella-shaped crown catches as much sun and air as possible. If trees of a different form were introduced into these forests and allowed to care for themselves they would soon succumb. The parasitic plants would soon break the branches of a tree that spread out close to the soil, while trees with narrow and upright crowns would not receive the necessary sun and air.

These forests are dependent upon moisture and a rich soil, and, to a lesser extent, upon temperature. While we find different species of trees composing the forests of the lower and upper parts of this zone, the general nature and aspect of the woods from the water-level to the crests of the cordillera are very much the same. Except where the soil differs or where the axe has interfered, the same forest covers the lower level lands and the slopes of the towering volcanoes, up to a certain height, where heavy frosts interfere with the growth of tropical plants.

Strictly speaking, however, this zone is not absolutely homogeneous. Wherever the soil is either poor, too sandy, or underlaid by hardpan, the forests give room to more open places, covered, not with tall trees, but with large and dense shrubs, in which the tall and slender bamboos take a prominent place. On the other hand, along the Pacific coast of Guatemala, we observe large dikes of lava rising in the shape of curiously-formed hills above the general level of the slope. On such *peñascos* the vegetation is less dense, but not the less interesting. However, as these localities are dependent only upon the nature of the soil for their distinctive vegetation, we do not classify them as distinct zones.

The magnificent forests are rapidly disappearing. At the time of my first visit to Guatemala the slopes of the volcanoes facing the Pacific were yet covered with them. In vain did I now hunt for these marvellous productions of a tropical nature in places where formerly they had attracted my attention. They had been cut and burnt, and sugar plantations or coffee *fincas* have taken their place, or herds of cattle pasture upon planted fields of *zacate* or forage. In twenty years more the Pacific coast will have no more primeval forests to show. The best preserved of the few remaining forests are found along the new coast railroad from Aguna to Mazatenango.

The Temperate Arboreal Zone.

This zone occupies the interior of Guatemala from the crest of the Pacific coast cordillera to the humid region of the north and east. As soon as the traveller has passed the culminating backbone of the cordillera he finds himself in a region less humid and more temperate than that of the coast. The luxuriant vegetation of the volcanic slopes or of the dense forests of the Alta Verapaz has given place to more open forests of oak and pine. To a large extent, these forests have long ago been cut down and fields of maize and beans have taken their place. Originally the whole

country was undoubtedly covered with a continuous belt of these trees, the *barrancas* or the topmost ridges being the only places characterized by a more luxuriant growth. The aspect of this zone is that of a forest region of the temperate parts of the United States, especially the foothills of California. We meet with four or five different kinds of oak and one or two of pine. The oaks are generally small or of medium growth, a large tree being an exception. The small size of the oaks seems principally due to the shallowness of the soil, as in places where the soil is deep and rich the same varieties attain to much larger dimensions. Gigantic oaks like those of the North American forests are, however, nowhere to be found. As far as I know, all of the oaks are of the evergreen kind. The pines are generally small and branched, and only one species seems suitable for lumber. These straight and tall pines are principally found in the northern cordillera in places where the temperate and the humid zones interlace, as will be described further on. The undergrowth in this zone is not as dense as in the lower zone of the cordillera. The trees are to some extent covered with climbing morning-glories, while on the horizontal branches live orchids in great variety, some of the handsomest species being found on the oaks of this zone. In open places and along the edge of the forests the ground is covered by a large variety of magnificent *compositæ*, among which the sunflowers are especially noteworthy and beautiful. Thus on the slopes connecting the humid warm zone with the present one we find extensive fields of brilliant flowers, principally gold and white. Nothing is more charming than the aspect of the lands between the volcanic peaks, which at the end of the rainy season present a wealth of colour such as is seen in the meadows of the high north. The difference is, however, that while in the north the plants are of low growth, in the tropics they are tall and bushy and the flowers large and luxuriant. In this floral display the morning-glories take a prominent place. Every few miles we meet with different species, characterized by distinct colouring, shape, and size. Some are gigantic, while others are lilliputian in size. Among the most charming fields of this nature were those on the slopes of the Volcan de Agua and the western sides of the lakes of Amatitlan and Atitlan. Even in the high sierra of the Department of Huehuetenango immense fields of compositæ charm the traveller with their rich colours and their delicate perfume.

Zonal Wedges in the High Sierras.

It is most natural to suppose that the two zones characteristic of the high sierra should follow each other with some regularity, as do the zones in more temperate regions outside of the tropics. But such is not the case; and this fact was one of those which appeared to me as of the greatest interest. The warm moist arboreal zone is everywhere in Guatemala known as the *Montaña*. It is characterized principally, while remaining in its primeval state of nature, by impenetrable evergreen forests of broad-leaved trees, bound together by dense thickets of climbers and parasitic plants, all indicating the immense fertility of tropical nature. The temperate arboreal zone is characterized by the scarcity of evergreen climbers, by the absence of an impenetrable undergrowth, by the presence of pines and other plants which indicate the more barren nature of a less luxuriant climate. In most countries such arboreal zones occupy different altitudes, the less luxuriant one being situated above the other. But in Guatemala this is not always the case. For instance, along the north and western slope of the high sierra, from Nenton towards the Mexican boundary and the western arm of the Rio Lacandon, we find that these two zones interlace with each other, occupying the same altitude side by side. Thus, for instance, in ascending from Chaculá (5,500 feet) to the higher altitudes of San Mateo Ixtatán, we can have our choice by passing through one or the other of these zones. Through the humid zone it is only with the greatest difficulty that we can make our way, every step being contested by *montaña*. But by following another trail, perhaps a mile to one side or the other, we may pass through comparatively dry pine forests, in which we look in vain for anything to remind us that we are in a tropical country, and by turning a little to the left or to the right, we can move from one zone of vegetation to the other. The main cause of this sudden change seems to be the drift of the clouds. If from a lower standpoint we observe the hills and the general movement of the clouds during the dry season, we find that day after day the clouds seek the same mountain slopes and tops. We may be absolutely certain that the slopes covered with cloud consist of *montaña* lands, while those which remain uncovered are clothed with pine forests. In this manner the two zones are often wedged into each other with great irregularity. The soil in the two zones is different. In the humid zone it is deep and black, and even during the dry season so wet that the trails are impassable. In the pine zone the soil is dry, shallow, and of chocolate colour, the very opposite to the former. This indicates that similar condi-

tions have existed from time immemorial—from the beginning, perhaps, of the Tertiary period. The most plausible explanation, if I may venture on one, of this phenomenon is that, owing to the configuration of the mountains and their situation between an upper colder zone and a lower warmer one, a certain regularity in the air currents has been established in such a manner that the cold currents always follow the same routes. Upon reaching the cold currents the moisture in the air condenses in the form of clouds, which, again, keep the vegetation green and luxuriant all the year round. As to the cause of these currents or zones of colder air, the configuration of the country and its mountain slopes has not given me any satisfactory clue.

The rock formation—of limestone bed-rock—is similar throughout, and there is no difference in the altitude of the two zones.

The Humid and Cold Arboreal Zone.

This zone occupies the high valleys of the northern sierra, as well as some of the upper slopes of the volcanoes. Its extent is not well defined, and it is less known than any of the other zones. The best samples of these magnificent forests are seen in the Departments of Huehuetenango and Alta Verapaz. Here we find them in the valleys connecting the high tablelands with the forests of the humid warm zone. In passing through Guatemala, from the capital northwards to the boundary of Mexico, we do not meet with any representatives of this zone until we reach the crest of the sierra north of Chiantla. Here we find that the oaks and pines of the tablelands of the last zone have given place to gigantic and magnificent cedars, vines, and cypress trees, with erect stems and large umbrella-shaped crowns. Nowhere have I seen anything in nature that has so inspired me with admiration and astonishment. No words can describe the beauty and magnificence of the trees. They stand close together, and, with a thick undergrowth of oaks and other semi-tropical trees, form masses of verdure, impenetrable alike to wind, and sun, and man. The clouds hang over these forests throughout the year, and the condensed fogs drip to the soil as an almost constant rain—at least during certain hours of the day. The individual trees are of majestic size and marvellous beauty, forming an assemblage perhaps not equalled elsewhere. The undergrowth consists of evergreen shrubs and smaller trees, especially of the family of *Vaccineæ*. Even the tropical forests of the coast-belt do not impress one as do these giants of the high sierra. On the higher rocky places the cedars are replaced by junipers hardly inferior in size and fully as beautiful in

form. The greatest altitude of this zone is about 12,000 feet, above which no trees are found. But as in this part of Guatemala few peaks reach any higher elevation, it is extremely rare to find any place not covered by dense forest. In the upper parts of this zone the traveller may expect to meet with heavy thundershowers and hailstorms during any time of the year, but especially during the months of June to September, and then principally in the early afternoon. During the rainy season these forests are rarely clear from fog or clouds more than a few hours in the forenoon. Already long before midday they cover themselves with clouds; while in the afternoon they are dripping with rain. The forests grow densely in the protected but precipitous valleys, the lower limit of which is about 7,000 to 8,000 feet in some localities; while perhaps only a few hundred yards away the lower limit is several thousand feet higher, the difference depending upon the currents of wind and the exposure. In these forests orchids are rare, and the density is not caused by parasites, but rather by the interlacing of trunks and branches. Happily for the preservation of these marvellous growths, few roads exist in these places, making it as yet unprofitable to export or utilize the lumber, but near the cultivated districts the trees have suffered much by fires started by the Indians. These forest lands are very fertile when once cleared, and in order to utilize them the natives cut some of the trees and then fire the brush. In this manner a great part has been destroyed. The worst consequence is that the land thus gained is not cultivated more than two years in succession. Already in the second year a new growth of different plants springs up, which the natives find too difficult to destroy. It is easier to fell new trees and to burn the ground over than to grub up the new weeds in the *milpas* (maize plantations). But where thus the old forests have been destroyed no new one of the same nature takes the place. The new growth consists of different trees, like those found in the temperate zone—oaks and low-growing pines. The cedars and cypresses do not return.

The Dry and Warm Zone.

This zone, which is one of the best characterized, occupies certain valleys in the central part of Guatemala. These valleys are all surrounded by high mountains, on the slopes of which the humidity of the air has been precipitated before it reaches the valleys during the rainy season. Similarly, during the dry season the moist northern and eastern winds are prevented by the high ridges of the sierra from modifying the climate of these valleys. The deep river basins of the Rio Grande and the Motagua belong

to this zone, and so do the depressed plains around Salamá and Cáhabón in Alta Verapaz. The traveller who descends into either of these valleys from the surrounding high and moist ridges finds himself suddenly in a territory of different temperature and vegetation. The cool air of the ridges has given place to intensely hot and dry calms, in which even the shadows of the *barrancas* give little or no relief. The luxuriant vegetation of the ridges has been superseded by deciduous trees of small growth and dense thickets or *chaparrales* of thorny bushes, while the open places are characterized by desert types, such as cactus, yucca, agave, bromelias, and other plants of the arid region. In this zone no crops can be profitably grown without irrigation, except corn, which, however, is raised to a very limited extent. On account of their high temperature these valleys are classed as the *tierra caliente*. Here flourish the cocoa palm, the sugar-cane, and other tropical plants which cannot support the low temperature of the temperate zone. The arid nature of this zone is due to several circumstances combined. The first is the scanty rainfall. Another cause is that a layer of hard clay, sometimes even of a rocky nature, lies close below the topsoil and prevents the absorption of the rain. This is the case in the valley of the Salamá and in that of Cáhabón. Another reason is the comparatively low elevation of the valleys, that of Salamá being less than 3,000 feet. This depression accounts for the greater heat of these valleys. In the valley of Salamá we find the surface often barren, only here and there covered with low, globular cacti, between which are smaller herbs and grasses, not dense enough to hide the soil. On the slopes of the low hills around the valley we find among the low shrubs, known as *chaparral*, dwarf fan-palms or palmetto. For fences in this region the cultivator plants tall, columnar cacti, which soon after planting become impenetrable by cattle. In slightly elevated and stony places we meet with different varieties of cacti, some of which are of considerable height and of columnar and branching form, while others partake of the nature of broad-leaved opuntias. A characteristic tree planted along the roadsides is the *ojote*, its branches being peculiarly twisted and noded and covered with a shiny yellowish-brown bark. But this so apparently inhospitable zone presents during the dry months of the year a floral display entirely unexpected. At that time the chaparral bushes are covered with multicoloured flowers in great variety, and it is evident that in this region the botanist will find a rich harvest of as yet unknown species. As pasture grounds for cattle these plains or hillsides are poor and only suitable during the rainy season. During the dry season the cattle must be driven

to the mountains. With irrigation, however, this territory becomes immensely fertile, as may be seen in the many fine plantations of sugar-cane in the vicinity of Salamá.

The Savannas.

These zones, which are nowhere continuous, occupy a very limited territory in the high sierra and on the upper part of the volcanoes of the cordillera. The cause of the limitation of these zones is not known with certainty, but it appears that the influencing factors are intense cold and heavy, perhaps at times drying winds. In this zone we find few or no trees, but often an abundance of bunch-grass. One of the most interesting localities of this zone is found above San Francisco el Alto on the road to Momostenango from Totonicapán. The hills are here covered with tall bunch-grass, while trees are entirely absent. Other somewhat similar savannas are found in the sierra of Huehuetenango and above Totonicapán on the road to Guatemala. In the Huehuetenango sierra the grassy plains are broken here and there by rocky ridges with low pines and numerous thickets of agave. While the soil in the pine lands and in the arboreal zone generally surrounding the savannas is of reddish clay, the savannas themselves consist of an intensely black, loose, and very fertile soil, utilized in places for the cultivation of potatoes and corn. It has already been stated that above the limits of the arboreal zone on the volcanic peaks we find a thousand-foot high zone. Besides the wide belt characterized by bunch-grass and the absence of trees, we find among the rocks and in the shelter of the cañons a fine growth of small tree-ferns in the loose soil, above a stratum which is solidly frozen during a large part of the year. The upper limit of the arboreal zone and the beginning of the savannas lies slightly above 4,000 metres (accord- to Ed. Rockstroh).

The Barren Zones.

The only barren zones in Guatemala are the very summits of some of the volcanoes, where the ejected sand and ashes have formed steep cones, on which no vegetation can get a foothold. Such barren cones are found on the volcanoes Pacaya, Fuego, Tacaná, and Cerro Quemado. On the latter there is no sand or ashes, the barren region consisting of ejected lava or andesite rocks. Outside of these few places every inch of land in Guatemala is covered with vegetation of some kind, and generally by one of great luxuriance.

THE CLIMATE OF THE PHILIPPINES.*

BY

WALTER S. TOWER.

The Philippine Islands lie about along the line connecting Borneo and Formosa, between Lat. 4° 45′ and 20° 3′ N. and Long. 116° 4′ and 126° 34′ E. The extension from north to south corresponds to the distance between Milwaukee and New Orleans. The number of the islands is not definitely known, but it has been estimated as high as 1,400. Their area is calculated as nearly equal to that of New England and New York State combined.

Supan, in his division of the world into climatic provinces, places the Philippines in the "Polynesian tropical" province, which is described as a "tropical climate ameliorated by the ocean, so that mild summer weather prevails throughout the year. On the loftier islands rain is abundant and has a tropical periodicity." In a less detailed classification the Philippines are included in the so-called "hot belt"—a temperature zone bounded by the mean annual isotherms of 68° F. The mean annual heat equator crosses the southern limit of Mindanao, one of the most southern islands. Most of the islands south of Luzon are in the area bounded by the mean annual isotherm of 80° F.; Luzon and a few small islands north of it are limited by the isotherms of 75° F. The whole archipelago is within the region of less than 5° of mean annual range of temperature.

The climate may be summarized as follows: High temperature throughout the year; small annual and relatively small diurnal ranges; humid, with excessive rainfalls at times; at certain seasons violent tropical storms, locally called *baguios*.

As the basis of our study of the Philippine climate it is necessary to take the observations made at Manila from 1885 to 1898, since data for other places in the archipelago, except in a few instances, are meagre, or else are entirely lacking.†

* This article formed part of a thesis on *Climate and Man in the Philippines*, written for the course in Climatological Research (Geology 26) given by Professor R. DeC. Ward, in Harvard University.

† Report of Philippine Commission, 1900, Vol. IV., pp. 129–357.

MEAN MONTHLY TEMPERATURES AT MANILA.

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR.
79.°5	80°.2	83°	85°.7	86°.1	84°.8	83°.5	83°.5	83°	83°	81°.7	79°.8	82°.9

Range: 5°.6.

If we compare these figures with those for Aparri, Lat. 18° 25′ N., and La Carlota, Lat. 10° 30′ N., respectively the most northerly and southerly points for which data are at hand, we find that the former has a mean annual temperature of 81°.7; a January mean of 76°.8; a June mean of 85°.9; and a mean annual range of 9°.1. The latter station has a mean annual of 82°.3; a January mean of 80°.6; an April–May mean of 84°.4; and a mean annual range of 3°.8. This comparison brings out the characteristic seasonal uniformity of tropical climate, combined with a sustained high temperature over the whole archipelago; the mean annual temperatures of Aparri and La Carlota differing by but 0°.6, although the two stations are separated by 8° of latitude.

The mean monthly absolute maxima and minima at Manila are given in the following table:

MEAN MONTHLY ABSOLUTE MAXIMA AND MINIMA.

	JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
Max....	92°.99	95°.0	97°.1	99°.4	100°.4	96°.1	95°.38	94°.8	94°.8	95°	94°.1	92°.8
Min....	65°.8	66°.4	68°.48	71°.9	75°.1	74°.9	74°.4	74°.4	74°.7	73°.3	70°.7	66°.9

The absolute maximum recorded was 103°.8, in May, 1889; and the absolute minimum 61°.8, in December, 1892. As regards the variation of temperature during the day, the minimum, as would be expected, comes just before sunrise, about 6 A.M.; and the maximum about 2 P.M. These hours vary slightly, from month to month, with the cloudiness. The mean diurnal range of temperature is as follows:

MEAN DIURNAL RANGE OF TEMPERATURE AT MANILA.

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
14°.4	16°.1	16°.3	16.7	13°.3	11°.4	9°.5	9°.1	8°.7	10°.6	10°.8	11°.7

The maximum diurnal range comes in the hottest month. The minimum range does not occur in the coldest month, but in September, which has nearly the maximum amount of cloudiness. Thus, the diurnal range is seen to be largely dependent upon the cloudiness; the clear months have large diurnal ranges, and the cloudy months small ranges.

From the fact that our climatic district is surrounded by the ocean on all sides, we should expect to find a high relative humidity. This expectation is borne out by the mean annual relative humidity of 79.4%; the maximum coming in September, the minimum in April. On the basis of observations made at Manila during the years 1856–1898, inclusive, the annual rainfall is 75.5 inches. This amount is distributed through the year as follows:

MEAN MONTHLY RAINFALL AT MANILA (INCHES).

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR.
1.2	0.4	0.7	1.1	4.2	9.6	14.6	13.9	14.9	7.5	5.1	2.1	75.5

Thus, there is a minimum of rain in the months from January to April, with the absolute minimum in February; and there is a maximum of rain in July, August, and September, with the absolute maximum in the latter month. These months of maximum and minimum rainfalls we should expect to find corresponding with the months having the maximum and minimum number of rainy days. (By a rainy day is meant a day on which a *trace* of rain is observed.) This correspondence is shown in the following table:

MEAN MONTHLY NUMBER OF RAINY DAYS AT MANILA.

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR.
5.1	2.8	3	3.7	9.1	15.6	20.6	20.3	20.2	16	11.17	7.9	135.9

Like all tropical regions, these islands are at times subject to excessive rainfalls. For example, the absolute maximum of rainfall during the period of years mentioned above was 117.3 inches, in 1867. In the same year the absolute maximum of monthly rainfall was recorded in September, 57.86 inches, 13.2 inches of which fell in a single day. The heaviest rainfall ever recorded, in a short time, was in August, 1899, when, under the influence of what is described as an "electric tempest," 1.96 inches of rain fell in 7 minutes.

The distribution of rainfall suggests a classification of the seasons in the Philippines, viz.: a wet season from June to October, and a dry season from November to May. This does not imply that the dry season is absolutely without rain, nor that there is a continual downpour in the rainy season. That this is far from being the case is brought out by a comparison of rainy days and the percentages of total rainfall in the two seasons.

NUMBER OF RAINY DAYS AND PER CENT. OF TOTAL RAINFALL IN THE WET AND DRY SEASONS.

	Rain.		Days of Rain.	
	Amount (inches).	Per cent.	Number.	Per cent.
Dry Season.....	14.95	20	43	31
Wet "	60.5	80	93	69

No month is absolutely without rain except in years of unusual dryness. Hence, although the seven months of the "dry" season have but 1/5 of the total rainfall, it is not absolutely a dry season. On the other hand, the rainy season is so called because the total rainfall is always greater than the amount precipitated in the other seven months. Some writers have used the terms wet and dry season as if they were applicable to the whole archipelago, and as embracing the same months at all places. Others contend that the terms can be applied to certain portions of the group only. In the islands of Panay, Cebú, and on the west coast of Mindanao, the dry and rainy seasons occur in the same months. The difficulty in applying this division of seasons to the islands of Luzon and Mindanao as a whole lies in their size, which makes it possible for topographic features so to control the precipitation that the wet and dry seasons may vary considerably as to time of occurrence within a relatively small area. This fact has often been noted by travellers, many of whom say that by planning one's route of travel carefully it is possible to avoid the rainy season altogether.

The mean monthly cloudiness for Manila is shown in the following table:

MEAN MONTHLY CLOUDINESS AT MANILA (0–10).

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
4.6	3.8	3.8	3.5	5.1	6.8	7.5	7.5	7.4	6.1	5.8	5.6	5.6

As would be expected, the months of maximum and minimum cloudiness are also the months of maximum and minimum rainfall. The months of maximum temperature, too, may be seen to correspond roughly with those of least cloudiness. The minimum temperature does not show this relation to maximum cloudiness, the former coming in January and the latter in September. The explanation of this fact probably lies in the position of the sun north of the equator at the time of greatest cloudiness.

During the greater part of the year the islands are under the influence of the northeast trade-winds; but the southward extent of the islands brings them under the influence of the diverted south-

east trades—the so-called southwest monsoon. The northeast wind blows during seven months of the year; the southwest wind being felt during the four summer months—June, July, August, and September; May and November have variable winds. At Manila the southwest wind prevails during six months of the year, from May to October; whereas the northeast wind prevails only from February to April. This peculiarity is probably due to some local condition arising from the situation of Manila at the head of a broad-mouthed bay, opening toward the southwest. The farther north one goes, the stronger becomes this trade-wind influence. At Aparri, in the northern part of Luzon, the most prevalent winds, even in the months from July to September, are from the northeast. At Iloilo, in Panay, the most southerly point for which data are obtainable, the prevailing winds during seven months of the year have the northerly components. In the other five months winds from the south and southwest prevail. This station, being 7° 8′ south of Aparri, feels the well-developed southwest monsoon; but even there the southwest wind does not prevail through as many months as at Manila.

Although it has been seen that certain months have a northeast wind, and others a southwest wind, these are not the only wind directions that are noted; nor is there a sudden change from one to the other. In passing from one season to another all the intermediate stages of wind direction are observed. The wind gradually shifts around the compass, in what may be called the transitional season, until it blows prevailingly from the opposite direction. With an east and west extension of the islands, prevailing winds would seem to offer a good basis for a classification of the seasons, but the fact that the southern islands have the southwest monsoon during a longer period makes it impossible to fix upon any seasons which shall comprise the same months in all parts of the islands.

The *baguios*, or typhoons, and the so-called "tornadoes" of the Philippines also need mention. *Baguios* are the oriental equivalent of our West Indian hurricane. They originate in the Pacific Ocean or in the China Sea, in the region bounded by 5° and 20° N. Lat. and 125° and 150° E. Long. These revolving storms are often of great violence, and cause much damage along the low-lying coasts. For example, the typhoon of October 30, 1875, destroyed over 3,000 houses and resulted in the loss of 250 lives. On this account a great deal of careful work has been done at the Manila Observatory, in order to bring the prediction of the baguios to the greatest possible degree of accuracy. At first predictions were based on

barometric indications only. These observations were sufficient as far as an indication of the existence of a typhoon was concerned, but gave no idea of the direction in which the vortex of the storm lay. More recently, the observations of clouds at Manila have been seen to furnish a reliable means of determining both the existence of a baguio and the bearing of the centre. In order to facilitate the determination of the storm's position, and of its probable distance, Father José Algué, Director of the Observatory, has invented his so-called *baro-cyclonometer*. This is an ingenious association of an aneroid barometer and a cyclonometer—the latter being a representation of the surface winds in a typhoon.*

Between 1880 and 1898, February was the only month in which no baguios occurred. During the other months they have been distributed as follows:

BAGUIOS AT MANILA FROM 1880 TO 1898.

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR.
6	0	3	9	24	35	66	63	79	54	40	18	397

The total, 397, represents the number of baguios which passed near enough to the Observatory at Manila to make their influence felt there.

"Tornadoes" in the Philippines are not the same phenomena as our well-known western storms of the same name, but are like our ordinary thunderstorms. That these are very frequent is seen from a record of those occurring at Manila from 1888 to 1897:

"TORNADOES" AT MANILA, 1888-1897.

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL.
29	16	89	321	1,003	907	697	621	623	529	168	47	5,050

This gives a monthly average of 1.6 for February, 100.3 for May, and a yearly average of 505 during the ten-year period. Like our thunderstorms, the "tornadoes" are less frequent between 7 and 11 A. M. Worcester speaks of thunderstorms as a regular occurrence shortly after 10 A.M. in Tawi Tawi, one of the most southerly islands†. The majority of more violent storms come in the afternoon; the intensity decreasing towards night.

The early Spanish settlers described the Philippine climate as "Seis meses de lodo, seis meses de polvo, seis meses de todo" (six months of mud, six months of dust, six months of everything).

* A description of this instrument, with illustrations, may be found in Report of Philippine Commission, 1900, Vol. IV., pp. 326-338.

† Worcester: "Philippine Islands and their People," p. 209.

A recent writer, recognizing a different phase of the climate, divides the year into "the small-pox season and the cholera season," corresponding roughly to the familiar classification into wet and dry seasons.* Others have described the climate as "lovely," or "deadly," or "not unhealthy for the tropics." It is hot throughout the year in the Philippines, and oppressively hot during a part of the year. The humidity is prevailingly high, and this, with the constant high temperatures, makes the heat hard to bear, and has an enervating effect on a Northern constitution. Some writers have claimed that people accustomed to the high summer temperature of our southwest will have no difficulty in enduring the heat of the Philippines. The dry air of Arizona and New Mexico, however, offers no parallel to the damp "hot-house" air of Manila. In these States the dry bulb thermometer may truly read 20°–25° higher, but the relative humidity is much less, and the *sensible* temperature, which the body feels, is much lower than in the Philippines. In some months, notably December, January, and February, the Philippine climate is at its best; for during these months the temperature and the humidity are both lower, the rainfall is light, and baguios and thunderstorms are least frequent. In these months, too, the nights are cooler. During the remainder of the year, however, the conditions of heat, humidity, heavy rains, and the greater prevalence of contagious diseases are undoubtedly very trying for Northerners.

Regarding the general situation in which a Northerner finds himself in the climate of the Philippines, Worcester says†:

> The facts are as follows: if one is permanently situated in a good locality, where he can secure suitable food and good drinking water; if he is scrupulously careful as to his diet, avoids excesses of all kinds, keeps out of the sun in the middle of the day, and refrains from severe and long-continued physical exertion, he is likely to remain well, always supposing that he is fortunate enough to escape malaria infection.

The question has also been answered by Maj. Chas. F. Mason, Surgeon 26th U. S. V. I, who says‡:

> If that term [acclimatization] is intended to convey the idea that the constitutions of white men gradually adjust themselves to tropical conditions and thereby become better able to withstand disease, then I do not think there is any such thing as acclimatization. Men do gradually learn to take better care of themselves, and to that extent are less liable to disease, but in my opinion the great majority of white men in the tropics suffer a gradual deterioration of health, and year by year become less and less fit for active service.

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* Hamm, M.A.: "Manila and the Philippines," p. 11.

† Loc. cit., p. 65.

‡ Rept. Surg.-Gen. U. S. A., 1901, 130.

Another officer says*

the most energetic and stalwart American after a year of service in the Philippines loses energy, strength, and ambition. He performs what work his duty demands in a more or less half-hearted way, and with a draft on his vital energy that he can actually feel at the time.

The London *Lancet*,† the leading medical journal in the world, in an editorial in which the experiences of the English in the tropics are largely taken as the basis of argument, maintains

that residence in hot climates under the circumstances of ordinary life has an adverse effect upon Europeans cannot, we think, be doubted. Some constitutions seem to be altogether unfitted for these climates, and such individuals lose their health and physical energy from the moment of their arrival. A still larger number do so sooner or later under a more protracted residence, even if they escape being attacked by one or the other of the endemic or epidemic diseases incidental to such climates. Residence in tropical and sub-tropical countries usually produces a very appreciable effect, not only on the complexion but on the constitution, and notably so during childhood and youth.

Prof. W. Z. Ripley, in summarizing the question of acclimatization as discussed by English, French, and German authorities,‡ says that the almost universal opinion seems to be that true colonization of the tropics by the white race is impossible. But

it must not be understood that by this is meant that the white man cannot live in the tropics. Hygienic precautions and great care often render a prolonged sojourn in these regions perfectly harmless. A colony can, however, never approximate even to the civilization of Europe until it can abolish or assimilate the native servile population; and yet one of the many things which are expressly forbidden to all colonists in the tropics is agricultural labor. . . . Let it be understood, then, that a colonial policy in the tropics means a permanent servile native population, which is manifestly inconsistent with a political independence, or with any approach to republican institutions.

The result of these conditions will probably be that few Americans will settle in the Philippines. A few will be obliged to go there as officials and soldiers; and they, by exercising great care, may live there with a fair chance of good health. The colonizing race must always be in small numbers, while the natives constitute the mass of the population. The separation of these two classes must surely give rise to serious governmental problems, while the native indolence of the Filipino will cause grave problems of labour.

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* Loc. cit., p. 130.

† Lancet, June 3, 1899, p. 501.

‡ Pop. Sci. Mo., XLVIII, 1896, 788–790.

TOPOGRAPHIC SURVEYS OF NEW JERSEY, MASSACHUSETTS AND OHIO.

Over fifteen years ago there was completed a topographic survey of the entire State of New Jersey, which was published on the scale of one mile to one inch, with contours having an interval of 10 and 20 feet. With the State of Massachusetts New Jersey shared the honour of being the first to have such a survey made, and in both cases the resulting maps have exerted potent influence for the development of water and sanitary works under State supervision, and of systems of well-constructed and well-maintained highways.

In both cases this work was executed in co-operation with the United States Geological Survey. Massachusetts left the entire supervision and conduct of the work to the Federal bureau, furnishing half the fund. New Jersey, however, stands alone among the States of the Union in having at first commenced, and in having wisely and economically carried out the survey of its own territory, under the sole direction of State officers. The late State Geologist, Dr. Cook, was in general charge of the Geological Survey of New Jersey, and under him the immediate technical conduct of the work was efficiently executed by Mr. C. C. Vermeule. After the survey was about half finished the State sought and received the co-operative aid of the United States Survey, but those in charge of the latter were so well satisfied with the quality of the work done that they reversed their usual procedure, and left the remaining work to be done by the same able hands, merely supplying the needed funds.

Within the last few years the present State Geologist, Dr. H. B. Kümmel, has undertaken a complete revision of the existing maps, the principal changes found necessary being in culture, chiefly the addition of new roads, streets, railroads, etc. This work is being carried on under Mr. Vermeule. While the results of the first survey were published on a scale of one mile to an inch, the manuscript maps were drawn on a much larger scale. In consequence, the results of the resurvey are being prepared for publication on the large scale of 2,000 feet to one inch for all the more densely-inhabited portion of the State, or at a scale of nearly three inches to one mile.

Already about a dozen map sheets of the new survey have been issued, and they are the most useful and the most satisfactory

topographic maps yet published of any large area of the United States. The scale is so large that it has been possible to add the names of all streets in the cities and villages, and, in consequence, these maps will be found especially useful to those engaged in engineering or allied work in the urban district.

During the present year the United States Geological Survey has taken a hand in this revision, with a view to hastening its completion; and it contemplates the resurvey this season of the unrevised portions of six sheets about High Bridge, Hackettstown, Lake Hopatcong, Somerville, Plainfield, and Morristown, or an area of nearly 1,200 square miles. It is reported, to the great credit of those who made the original surveys on the smaller scale, that practically no errors have been found in culture, and that the contour topographic sketching is remarkably good, though somewhat generalized in places, and lacking the detail shown in the later maps of the Federal survey. Unfortunately, it has not been found possible to incur the expenditure required to revise the contour sketching as well as the culture.

The State of Massachusetts, like New Jersey, did not stop with the completion of its topographic survey, but has been ever since actively engaged on kindred work. It has thus far done nothing towards the revision of the existing maps, but has entered upon a cadastral survey of the commonwealth. This work consists in extending a minute system of triangulation of the highest order of geodetic precision over the State, whereby permanent monuments are located at intervals of a few miles. Several of these are placed on the boundaries of each township, and the outlines of the latter are then traversed with an accurate tape and transit survey tied to the triangulation monuments. The result is to furnish a vast system of precisely-located political and property lines to which all future property lines can be tied. In addition, these cadastral surveys will furnish the instrumental control on which at some future time a thorough and accurate revision of the topographic survey can be based.

This is, in fact, what has recently been done by the United States Geological Survey for the Metropolitan District of Boston, and the result is about to be published in a new edition of the Boston and Boston Bay sheets. Towards the construction of these sheets there were available many hundreds of geodetic positions, chiefly on town boundaries, but including also church spires, factory chimneys, hill-tops, etc. Numerous lines of spirit levels were run over the whole area of survey, and the finished map is of sufficient accu-

racy to furnish a base on which not only to plan but even to project the extension of roads, railroads, and the plans of other engineering works. A preliminary but limited edition of this map, in the form of a black-and-white photo-lithograph, has already been issued on the large scale of over two inches to one mile, and has been found most useful by the various metropolitan bureaux.

Topography of Ohio.

The diverse topographic features of the State of Ohio are well brought out in the series of maps which are rapidly following one another from the presses of the United States Geological Survey, as a result of the liberal appropriations towards co-operative topographic surveys made by the last two legislatures of the State.

Already, after only three seasons of field work, the survey of thirty-two sheets has been completed. These represent the topography, on a scale of one mile to one inch and with contours of 10 and 20 feet, of nearly 6,000 square miles. Two widely-divergent types of topography are represented by the northwestern and the southeastern portions of the State. The Sandusky sheet, for example, had to be mapped with contour interval of 10 feet in order that the very gentle slopes along the low-lying lands on Lake Erie might be properly represented. The country is quite level, the uniformity of the slopes being broken by two features characteristic of the entire lake border series of sheets. These are clearly-defined terraces and benches outlining old lake beaches, and deep-cut ravines which carry the drainage from the uplands to the south into Lake Erie. The old shore-lines, as marked by the beach terraces, are a delight to the student of geology, and these, as well as the deep-cut ravines, are, perhaps, best expressed by the Cleveland sheet, through which the Cuyahoga Creek meanders in a deeply-eroded channel.

In the southeastern portion of the State the higher summits of the country mark the general level of an upland or plateau of nearly uniform elevation and gentle inclination. The surface of this plateau has been deeply and minutely eroded by myriads of little streams draining into the Ohio River. A fine example of this topographic type is shown in the Parkersburg sheet, a preliminary photo-lithograph of which has just been issued. The minuteness with which this exceedingly detailed topography has been mapped is such that the map is very difficult to read; yet had any larger contour interval than 20 feet been used much of the value and accuracy of the map would have been lost.

H. M. W.

GEOGRAPHICAL RECORD.

AMERICA.

PROJECTED RAILWAYS IN CANADA.—Considerable interest attaches to the plan to extend the Grand Trunk Railway of Canada to the Pacific Ocean, its projected line being to the north of the present Canadian Pacific, and to build a new Trans-Canada road still farther north than the Grand Trunk extension. The high latitudes which these roads, especially the Trans-Canada, are to traverse, bring up the question of the climatic difficulties that may be encountered. While it is generally known that Manitoba is a fine wheat country, comparatively few persons yet realize the agricultural possibilities of the great Canadian West. One secret of the success of farming in the western provinces of Canada, east of the Rocky Mountains, lies in the comparatively high summer temperatures over a large portion of the district. During the summer months pretty uniform temperatures prevail in Alberta, the Peace River district, and northward almost to the Arctic Circle. In July the mean temperature at Winnipeg is 66° Fahr., and at Prince Albert 62°, the former being higher than that in any part of England. The average daily maximum temperature at Winnipeg is 78.1°, the minimum being 53.4°, and at Prince Albert the maximum is 76°, and the minimum 48°. It is these high day temperatures in summer, with abundant sunshine and, on the whole, sufficient and well-distributed rainfall, that cause the crops to mature so quickly. The northerly limit of wheat in northwestern Canada is about as far north of the projected Trans-Canada Railway line as that line is north of the international boundary. There is but little snowfall in winter; the warm chinook winds temper the cold near the mountains, and spring begins in the western districts earlier than in the eastern. The great "trek" of American farmers across the border into the Canadian West is recent evidence of the agricultural possibilities of these sections. Besides the grain, there are favourable conditions for cattle-raising, and in the mountains there are vast areas of woodland, as well as rich mineral deposits. The winters are long, but there is not much snowfall, and with plenty of sunshine and a clear, dry air during the colder months, together with a short but favourable summer for crop growth, the Canadian plains are not as inhospitable or as hopeless as they have sometimes been supposed to be. R. DEC. W.

River Surveys in the South.—A most useful geographical and engineering work has been recently begun by the Hydrographic branch of the United States Geological Survey. This is the making of a detailed combined topographic and hydrographic survey of the river systems throughout the United States. Already much related work has been done by the Army engineers below the *fall line* along the coastal borders and greater navigable rivers, in connection with river and harbour surveys. The present survey commences where these stop, and is carried through the Piedmont region and the interior of the country from the fall line to the headwaters of the larger branches.

The purpose is to make an exhaustive study of all those facts which are essential to a full knowledge of the nature, volume, and regimen of the streams, and their value as sources of water supply for power or domestic use. For a number of years past the Survey Bureau has maintained gauging stations, at which the daily and annual mean, maximum, and minimum discharge of the streams are being systematically measured. These results, supplemented by the Weather Bureau records of rainfall on the catchment basins of the streams, and a knowledge of their areas as measured from the topographic maps, furnish all the data from which to ascertain the available water supply of any stream at any time or place.

The additional work now being undertaken in the river surveys consists in making a large-scale contour of each stream bottom for a short distance only outside of the immediately confining banks, accompanied by a careful line of spirit levels. The results are plotted on maps having a scale of about three inches to one mile, with contours of ten feet interval. The profile of the surface of the water is plotted on a suitable scale, and the exact elevations at the tops and bottoms of all shoals, rapids, and falls are determined. Moreover, elaborate notes are made of the stage of waters, floodmarks, cultivated lands, and woods, the whole accompanied by numerous photographs.

As may be readily seen, the resulting maps and reports will furnish all the information necessary to an understanding of the possibilities of every stream in connection with the development of water resources of all kinds. The fall or slope shows the head available for power, and the volumes of flow are known. The maps indicate possible flats for water storage, as well as possible sites for diversion, storage, or mill dams, while photographs and notes give an idea of the topography and of the earth, rock, timber, and other materials of construction. H. M. W.

A Herd of Bison in Northwestern Montana.—The University of Montana, Missoula, maintains a Biological Station near Flathead Lake, in the northwestern part of the State. Professor Morton J. Elrod, Director of the Station, describes in *A Biological Reconnoissance*, published last year by the University, the herd of 220 buffaloes on the Flathead Indian Reservation. The herd, derived from 36 animals purchased in 1884 by Charles Allard and Michael Pablo, has in 20 years increased to more than 350, or ten times the original number. Many of the animals have been sold to show enterprises and to Eastern cities for parks and zoological gardens. The conditions here are more favourable for buffalo than in Yellowstone Park. The animals are constantly attended by a herder, and, therefore, are not afraid of man, while the Yellowstone Park herd is rarely seen.

The Park herd also ranges at a high altitude, over 7,000 feet, where snows are deep and winters are long and severe; but the Flathead herd ranges at an altitude below 3,000 feet, where deep snows do not occur, and hay or grain may be taken to the animals in a few hours. Their range does not exceed 70 to 100 square miles, and the animals might be maintained on a much smaller range. The cows do not bear calves until they are 4 or 5 years old, and about half of them produce every year. The fertility of the herd is not decreasing. The herder keeps note of the increase, looks after the calves, and, in fact, the animals are much more carefully attended than the range cattle among whom they graze.

Professor Elrod is of the opinion that the success of this private enterprise should stimulate Congress to increase its efforts to save the buffalo from extinction. An appropriation of $8,000 would buy as large a herd as Allard and Pablo purchased in the beginning. With the same care the herd should increase to between 400 and 500 in twenty years. If a tract of land containing from 50 to 100 square miles were set apart for a buffalo range, with an appropriation at the start of $15,000, and an annual appropriation of $5,000, there would be no difficulty in developing a herd that would be a credit to the nation. The care of the herd should be placed under the jurisdiction of the Biological Survey of the Department of Agriculture. It is hardly to be expected that the animals will thrive in Yellowstone Park, where the winters are long and severe, the summers short, and protection is afforded to wild animals, which prey upon the calves.

AFRICA.

MINERALS IN GERMAN EAST AFRICA.—Mr. Max Moisel has prepared a map of German East Africa on a scale of 1:2,000,000, showing the existing knowledge of its topography, and the distribution of useful minerals as far as they have been discovered. The map is reproduced on a smaller scale in the *Deutsche Kolonialzeitung* (No. 15, 1903). Placer gold has been found along the banks of some of the rivers, both near the south coast of Victoria Nyanza and between Lake Nyasa and the Indian Ocean. Among the Useraguru Mountains, near Emin Pasha Gulf, Victoria Nyanza, outcrops of gold-bearing quartz have also been discovered. It is expected soon to work some of the placer diggings. Iron is very widely distributed; excellent anthracite is found near the northern shores of Lake Nyasa, but beds of bituminous coal brought to light appear to be of inferior quality. Lead, copper, granite, kaolin, bitumen, mica, lignite, and agates are among other mineral resources which may some day prove profitable.

THE TUBURI SWAMP.—About half a century ago, Heinrich Barth discovered a widespread swamp to the west of Lake Chad which appeared to be so perfectly balanced on the water-parting that, in his opinion, it was drained partly into Lake Chad and partly into the Atlantic Ocean. This connection between the Chad and the Atlantic drainage system has now been proved to exist. The solution of the question has devolved upon the French expedition commanded by Capt. Loefler. Starting from Carnot, the chief station on the upper Sanga, he crossed the water-parting (850 metres above sea-level), between the Sanga, the Mobangi, and the Shari.

BIBLIOGRAPHY OF MOROCCO.—The exhaustive bibliography of Morocco to the end of 1891, prepared by Sir L. Playfair and Dr. R. Brown, and containing 2,243 titles (*Supplementary Papers* of the Royal Geographical Society, Vol. III, Part 3), is now supplemented by the bibliography attached to Mr. Camille Fidel's long paper "Les Interêts Economiques de la France au Maroc" (*Bulletin Trimestriel* of the Oran Geographical and Archæological Society, No. 94), in which he includes the most important works on Morocco since 1891—a period that has been peculiarly rich in literature on that country. Mr. Fidel's list embraces those books and papers which are specially valuable in an economic sense.

ASIA.

GERMAN COLONY OF KIAOCHAU.—Dr. Georg Wegener, in an

article in the *Geographische Zeitschrift* (1903, No. 4), says that the harbour of Kiaochau Bay does not fill all desirable conditions. The bay is so large that the northwest storms, frequent in winter, endanger the shipping. This difficulty will be obviated, however, by the completion of the mole, which will be 4½ kilometres in length, 5 metres in width, and 5 metres above high tide. Under the protection of this mole two havens are being built. The smaller has, in fact, been completed, and is now utilized by vessels drawing not more than 5 metres. The larger, adapted for the greatest ocean vessels, is nearing completion. The dry dock, which will be the largest on the east coast of Asia, will be ready for use in 1904. The bay is undoubtedly the best harbour north of the Yangtse; but its potentialities for fostering the growth of trade are latent, and must be developed by the great commercial Power that now holds it. Trade with the populous interior will be created chiefly through the railroad now building from the Bay to western Shantung. Great improvements have been made at Tsingtau, the starting-point of the railroad, and the port of the Bay. Wide, well-built streets, commodious dwellings and business houses, and healthful barracks for the troops have been constructed. A large lighthouse is building at the entrance to the Bay.

AUSTRALIA.

THE PROPOSED TRANS-CONTINENTAL RAILWAY IN AUSTRALIA.—The projected railway across Australia, from Adelaide on the south to Port Darwin on the north, a distance of 1,896 miles, is to cut right through the central portion of the country, and is one of the many interesting railway enterprises of the present day. On the south the railway now reaches Oodnadatta, 688 miles north of Adelaide, and on the north it is built from Port Darwin to Pine Creek, a distance of 145 miles. As to the climatic conditions of the great interior district which is to be traversed, very little is known. It used to be thought altogether a hopeless desert. Then came reports that the climate around the MacDonnell Range was "splendid" and the country very fertile. Later, the Horn Expedition resulted in modifying the too favourable opinion which had been formed by the natural reaction from the earliest ideas. Horn found the ranges bare ridges, separated by sandy flats. In 1862, McDouall Stuart made his third, and successful, attempt to cross the continent from south to north. He found that the Bonney River, in latitude 20° 24′, which when last seen in March was a fine stream, in September was a series of water-holes. The

tracks of the expedition of the previous year were plainly visible, which showed that no rain had fallen in the meantime. Central Australia evidently shares with other arid regions the characteristic of having great irregularity of rainfall from year to year. The MacDonnell Range receives occasional heavy showers, which fill up the streams and even flood the lower country. When a traveller comes at such a time he finds a luxuriant growth of vegetation; while one who comes later or earlier may take back a very different story. Over the central portion of the route to be traversed by the railway the rainfall may average about five inches a year; but towards the northern end of the line, in the Northern Territory proper, or Arnhem Land, there is more rainfall and a possibility of vast wealth. In the north, rice, sugar-cane, tobacco, and coffee flourish; while to the south the greater part of the country is suited for breeding sheep, cattle, and horses. It has been stated that the country may be expected to carry 30,000,000 sheep. In supporting the railway bill, the Premier of Australia recently said: "The territory is bound to became the great cattle-producing country of the world; no other part is so suitable for cheap and extensive production."

R. DEC. W.

CLIMATOLOGY.

CLIMATIC CONTROL OF RAILROAD CONSTRUCTION AND OPERATION.—In the construction and operation of railroads in different parts of the world, many of the chief difficulties encountered arise from the climatic conditions of the regions traversed. Some of these difficulties, and the way in which man has met them, are considered in a recent article on *Climatic Factors in Railroad Construction and Operation*, by Robert M. Brown (Journ. Geogr., April, 1903, 178–190). The railroad districts of the world are classified by the author into Regions of Heavy Precipitation; Regions of Moderate Precipitation; Regions of High Altitudes, and Regions of Severe Winters. In the first of these districts, where the rainy seasons usually alternate with dry seasons, much trouble arises from the fact that the ties decay, and have to be preserved by creosoting, or else must frequently be renewed. In any case the expense involved is very considerable. During the dry season the hot sun may warp and split the sleepers so that they must be renewed, and there is also difficulty in supplying the labourers with pure water. Early in the history of the Sind Railway, in India, a system of water-carts and bullocks, and later of water-trains, was organized for carrying drinking water to the men. The scanty supply of pure water for

use in the locomotives is another serious handicap. The number of working days is much decreased by the heavy rainfall of the wet season and by the excessive heat of the dry season. In the construction of one road in India work was impossible between 9 A.M. and 4 P.M. During the rainy season "the history of every road that traverses the belt of heavy precipitation is a story of continued struggle against flood" and landslides. In Ceylon a rainfall of 28.56 inches in eleven days caused so many landslides near Nanu that traffic was interrupted for six weeks, and the La Guayra and Carácas Railroad, in Venezuela, is frequently similarly blocked during the rainy season. On the other hand, in the dry season much difficulty has been experienced because of the damage to machinery and bearings through dust.

Regions of light precipitation, which include the deserts of the world, present climatic problems to the engineers which are often very difficult to solve. The great danger from fire in the case of ties, bridges, and buildings often necessitates fire stations and fire patrols. Water has to be carried or piped for long distances, as in the case of the Southern Railway of Peru and of the Iquique Railway of Chile. Work has often to be suspended during the noon hours. The absence of wood and coal for fuel has, in several cases, led to the use of oil. Blowing sand covers the tracks, and necessitates the employment of labourers to keep the road cleared.

In regions of high altitudes there are the difficulties which arise from mountain sickness and from the cold, both during the construction and after the completion of the road. A part of the new Jungfrau Railway is run through a tunnel to protect it from the winter snow blockades, which are serious handicaps to many railroads. It cost the Colorado Midland Railroad $60,000 to clear its track of snow during the late winter of one year recently.

The Trans-Siberian road is a good example of a railroad built in a region of severe winters. Temporary rails were laid on the ice during the period of construction, and ice-breakers have been employed to keep Lake Baikal open, so that the cars may be ferried across.

R. DEC. W.

LONDON FOGS.—Captain Alfred Carpenter, R.N., who has been conducting the official inquiry into the occurrence and distribution of fog in London, has presented a report to the Meteorological Council of the Royal Society on the results obtained for the year 1901–02. Among the most important conclusions thus far reached are the following: The commencement of a fog is a general process,

depending upon general atmospheric conditions. There is no evidence that fogs formed outside invade or drift into London. London fogs are produced in London. During dense fogs in London there is a tendency to an indraught of air from all sides to the central parts of the city. No severe fog occurred with a temperature above 40° Fahr. On March 7, during a fog, the temperature in the streets was nearly 10° Fahr. below that on the roof of the Meteorological Office, at the elevated stations, and over the surrounding country on the south and west. It is proposed to carry on the investigation, and especially to study the vertical decrease of temperature before and during fogs. R. DEC. W.

PHYSICAL GEOGRAPHY.

VOLCANIC ERUPTIONS IN SAMOA.—The German Government received, in February, official and private accounts of the volcanic eruptions which began in Savaii, the largest and most western island of the Samoan group, in October last. Dr. Georg Wegener, of Berlin, has an article based on these reports in the *Zeitschrift* of the Berlin Geographical Society (No. 3, 1903), from which the following facts are taken:

The eruptions were a great surprise to the islanders; though the entire group is formed of volcanic outpourings, excepting the little atoll Rose and a number of coral reefs, no evidences of existing energy at the present time were known. There were no solfataras, fumaroles, or hot springs to show that plutonic energy was not entirely extinct. Since the recent outburst a half-forgotten tradition has been revived, to the effect that long ago, perhaps about 1690 A.D., a very severe eruption on Savaii destroyed ninety-five villages. This story must, however, be received with reserve. It is evident that vulcanism in the archipelago gradually subsided from the east to the west, the eastern islands being evidently older than those in the west. In the Manua and Tutuila groups (United States) of the east, for example, the ancient craters have entirely or to a large extent disappeared through denudation, while in the western island of Savaii well-formed craters still remain. The larger denudation and the formation of humus in the eastern islands have also resulted in a deep rich soil, while in Savaii a great part of the island is not adapted for tillage. These facts are interesting to us in their bearing upon the non-liability of our island Tutuila to suffer from such disasters.

The news of the eruption was brought to Apia, the capital of German Samoa, on Upolu island, on November 2, by an English-

man named Williams, who crossed from Savaii in an open boat. He said that severe earthquakes, which overturned stone walls, were felt on the north coast on October 29th. "Smoke" was seen to be rising above the interior mountains on the 30th, and that night subterranean rumblings were heard. These phenomena continued up to the time that Williams left the island. Dr. Schnee, Governor of German Samoa, and Dr. Tetens, the astronomer, went to Savaii on November 3d. That evening they observed flames rising to a height of 100 to 200 metres about 17 miles southwest of south from Mataatu, the chief town of the island on the northeast coast. The natives along the north coast had been greatly alarmed, and most of them fled to the east.

On November 7th a very severe earthquake occurred, which badly damaged several Mission churches in Safune and Sasina, on the coast, and destroyed the village of Paia. On the same day Dr. Tetens, in the midst of a hard rain, pushed inland, and on the following day he camped, at a height of 1,460 metres above the sea, in the neighbourhood of Manga Afi, a long-extinct volcano, within plain view of the column of dust and fire-glow that was rising above the trees. The seat of the explosion was on the slope of Manga Afi, about 50 metres below the old crater at its summit, and about three-fifths of a mile from it. The ascending dust column varied in strength from time to time. Glowing bodies at very frequent intervals were ejected to a height of about 100 metres, most of them falling back into the opening. The scene did not give an impression of great energy. The crater edge could not be seen on account of the burned timber around it. A remarkable discovery was made about 3 kilometres northwest of the crater. A rough wall or ridge of pumice-like stone, measuring from 10 to 50 centimetres or more, and still so hot that the barefooted Samoans could not step on it, rose to a height of 5 to 10 metres. This "stone stream," which undoubtedly came from the new crater, and was about 150 metres lower down the slope, was from 5 to 10 metres in height. Its width and length were not ascertained. No flowing lava was observed.

On November 18th, Surveyor Lammert approached the centre of disturbance from the south side of the island, and found another active crater from 600 to 800 metres southwest of the one which Dr. Tetens had discovered. He also found that the crater which Tetens approached had an east-west axis 800 to 1,000 metres in length. Through five or six cracks in the surface of the slope, also, little shoots of flame rose to a height of only one to two metres. The

air at times was so charged with gases that it was difficult to breathe. All vegetation had been destroyed near the craters, and the forests were burning for a considerable distance around. Herr Lammert was not able to reach the crater he had discovered, but saw that its activity was increased after a sharp earthquake shock.

No further news has been received. Dr. Wegener is of the opinion that the eruptions have subsided, or at least have not intensified, for otherwise vessels arriving in Australia or San Francisco would have reported the fact. He calls attention to one interesting feature. It is generally supposed that the degree of energy displayed by a reawakened volcano is proportioned to the length of its period of rest; the longer the period, the more violent the outburst when it comes. In Savaii, however, though apparently no volcanic outburst had occurred for some centuries, the energy of the recent eruption has been comparatively unimportant; the subterranean power seems to have found some easy way to reach the outer air.

Formation of Barrier Reefs and Different Types of Atolls.—Professor Alexander Agassiz has summarized his results, based upon observations of barrier reefs and atolls, carried on during the past twenty-five years, for the *Proceedings* of the Royal Society (No. 474, 1903). He recognizes the fact that Darwin's theory does not explain the conditions now observed, but limits his report to descriptions of the different types of coral reefs and of their probable causes, without attempting to establish any independent theory. He has found that the barrier reefs of Fiji, Hawaii, and the West Indies are underlaid by volcanic rocks and usually flank volcanic islands. Those of New Caledonia, Australia, Florida, Honduras, and the Bahamas are underlaid by outliers of the adjoining land masses. Some of the barrier reefs of the Society Islands, Fiji, and the Carolines show that the wide, deep lagoons separating them from the land mass were formed by erosion from a broad, fringing reef flat. Encircling reefs, as in the Society Islands, hold to their central island or islands the same relation which a barrier reef holds to the adjoining land mass. Denudation and submarine erosion account for the formation of platforms upon which coral and other limestone organisms may build either barrier or encircling reefs, or even atolls rising upon a volcanic base.

We may trace plateaux that have been elevated, like Guam, partly volcanic and partly limestone, to atolls where only a small islet or a larger island of either limestone or volcanic rock is left

to indicate its origin. Atolls may also be formed upon the denuded rim of a volcanic crater, as at Totoya, in Fiji. Many of the atolls in the Pacific are merely shallow sinks formed by high sandbanks thrown up around a central area. Throughout the Pacific, the Indian Ocean, and the West Indies the most positive evidence exists of a moderate recent elevation of the coral reefs. Closed atolls can scarcely be said to exist; Niau, in the Paumotus, is the nearest approach to one, yet its shallow lagoon is fed by the sea through its porous ring. The land area of an atoll is relatively small compared with that of the half-submerged reef flats. In the Marshall Islands and the Maldives, for example, the land areas are reduced to a minimum. Atolls may rise from a platform of suitable depth wherever and however it may have been formed and whatever may be its geological structure. The great coral reef regions are within the limits of the trades and monsoons and the areas of elevation, with the exception of the Ellice and Marshall Islands and some of the Line islands. Corals have their fullest development on the sea face of reefs; they grow sparingly in lagoons where coralline algæ grow most luxuriantly. Nullipores and corallines form an important part of the reef-building material.

ECONOMIC AND COMMERCIAL GEOGRAPHY.

Western Movement of Coal in the United States.—In the entire region between the Appalachian coal field and the Rocky Mountain fields a general Western movement of the coal is observed. Thus the product of the Western Interior field (the coal-belt from north Iowa to central Texas) goes West almost exclusively; that of the Eastern Interior field (portions of Indiana, Illinois, and Kentucky) goes West to and within the borders of the Western Interior field, while the Appalachian coal goes west across both the Eastern and Western Interior fields and beyond the territory of the latter, competing with the Rocky Mountain coals to some extent. This westward tendency is due chiefly to the higher grade of Eastern coal; in part, also, to the fact that railroad freight rates are generally lower westward than eastward; water transportation also favours the westward rather than the eastward movement of coal (*Contributions to Economic Geology. 1902. Bulletin* No. 213, United States Geological Survey).

Henequen in Yucatan.—Consul E. H. Thompson, of Progreso, Yucatan, contributes to *Advance Sheets* of the Consular Reports (Feb. 28, 1903) an interesting account of the chief product of

Yucatan. Sisal grass, sisal hemp, henequen, or simply sisal, are names applied to a fibre that is neither a grass nor a hemp, and is not produced to any extent in Sisal. The name sisal was given to it because, until 1871, Sisal was the only port through which it was exported. When a railroad built to Progreso gave a shorter route to the coast, the exports were entirely transferred to that port. Its wharves are now lined with shipping, and the streets are filled with bales of henequen ready to be sent out in exchange for the general merchandise that comes in. The *Agave americana* produces the pulque, which is the national beverage of Mexico. Another member of the agave family, the *Agave sisalensis*, supplies the fibre which is so widely used in our country for cotton sacking, binders' twine, rope, and other articles. The cultivation of henequen was not important till the invention of fibre-cleaning machinery. With the aid of one machine two men can now clean more fibre in a day than forty were formerly able to do. There are five different machines, each of which can strip the fibre from 150,000 agave leaves in ten hours. The output has steadily increased for ten years, and amounted in the fiscal year ending June, 1902, to 564,308 bales.

Brazil Rubber.—Mr. A. Kähler, who has spent five years on the Amazon, gives an interesting account in *Petermanns Mitteilungen* (February, 1903) of the methods of collecting rubber in the forests of Brazil. Rubber of the best quality and largest quantity comes into the trade under the name of Pará rubber or Pará-fina. The tree from which it is derived (*Siphonia elastica*) is widely spread over the lowlands, and thrives best where the land in the rainy season is almost completely flooded. It has a straight, silver-coloured trunk, and attains a height of 60 to 80 feet. The collector requires about two hundred trees, collecting sap from half of them on one day and from the other half on the day following, thus alternating through the season, which covers the drier months from May to October. The workman goes from tree to tree, making short incisions through the bark with a small hatchet. Under each incision he presses into the bark the sharp lip of a tin cup, which catches the sap. The incisions close completely in about two hours, when the cups are collected and the sap is carried to his hut. The afternoon is given to smoking and coagulating the morning's collection. The average amount gathered by a collector in the season is from 400 to 500 kilograms, which usually sells in Europe for about $1.85 a kilogram. There is scarcely any vegetable product that brings so high a price as Pará rubber. It is usual to

give the *siphonia* a rest of a year after it has yielded annually for four or five years. Plantations for the cultivation of this tree have been started, but the cultivated *siphonia* seems to yield less sap than the wild tree, and the product is of poorer quality. The other variety of Brazilian rubber is extracted from the caoutchouc tree, also widely distributed; it seems likely to be exterminated, because the tree must be destroyed to obtain the sap. The milk runs so rapidly that no way has yet been discovered of collecting it while the tree is standing. The *siphonia*, on the other hand, may be counted upon as a great and permanent resource.

Live Stock in Germany.—The following figures, condensed from a table in *Vierteljahrshefte zur Statistik des Deutschen Reichs* (Ergänzungsheft zu 1903), show the number of live stock (the larger classes) in Germany in three census years; the decline in the sheep industry has been very marked:

	1873.	1892.	1900.
Horses.....	3,352,231	3,836,273	4,195,361
Cattle.....	15,776,702	17,555,834	18,939,692
Sheep.....	24,999,406	13,589,662	9,692,501
Swine.....	7,124,088	12,174,442	16,807,014
Goats	2,320,002	3,091,508	3,266,997

Freight Haulage in Madagascar.—The excellent wagon roads, completed in 1901, between Antananarive, the capital of Madagascar, and the ports of Tamatave, on the east, and Majunga on the west coasts, have revolutionized the methods of freight carriage. Human porterage has been almost entirely supplanted by freight wagons hauled by men. In the last six months of 1902, 4,026 freight wagons were hauled to Antananarive by 11,831 men, all but 156 wagons starting from Tamatave. In the same time only 505 porters carried loads between the sea and the capital, though, in 1901, 48,600 men were engaged in the porterage service. The economy of the new method of carriage is illustrated by the fact that the freight in 1902, carried by wagons hauled by 23,590 men, would have required 62,418 men to carry it on their backs. Haulage by mules and oxen is still small, but is increasing (*Bulletin Économique*, No. 4, 1902).

Manufacturing Industries in Sweden.—From 1896 to 1901 the number of manufacturing establishments in Sweden increased from 8,812 to 10,904; of workpeople in them from 202,293 to 262,229; and the total value of the product from $192,487,400 to

$285,010,200. Saw mills contributed, in 1901, 13.53 per cent. of the total value of product; flour mills, 7.70 per cent.; textile mills, 5.22 per cent.; machine shops, 5.14 per cent., and iron and steel manufactures and foundries, 5.01 per cent. (*Bidrag till Sveriges Officiela Statistik.* Fabriker och Handtverk, 1901).

THE WORLD'S CEREAL CROPS IN 1902.—The world's yield of cereals in 1902, as estimated by *Broomhall*, was: Wheat, 3,072,000,000 bushels; maize, 2,975,000,000; oats, 3,172,700,000; barley, 1,027,100,000; rye, 1,518,000,000. The United States produced 84 per cent. of the world's maize and 22 per cent. of the wheat. Russia produced 40 per cent. of the barley and 55 per cent. of the rye.

MAPS AND CHARTS.

THE BEST MAPS.—Professor Israel C. Russell, of Michigan University, gave an address before the Michigan Academy of Science, at its ninth annual meeting, on topographic maps and the topographical survey of Michigan. He said the most enlightened nations of Europe are in advance of all others in the completeness and accuracy with which their domains have been surveyed and mapped. Germany, France, and England, in particular, have excellent maps of their territory, and, in many instances, most conspicuously in the case of the English in India, the same desire for accurate information has been extended to their colonial possessions. Similar maps embracing any considerable areas in America were almost unknown up to the organization of the United States Geological Survey in 1879. Even at the present time creditable maps of the entire area of only four States are at hand; and in Michigan less topographic work has been done than in any other State, with the exception of Florida and Minnesota.

These best maps, in addition to representing the relative positions of objects on the earth's surface, indicate with equal accuracy the heights and shapes of mountains and hills, the forms of valleys and the slopes of their enclosing uplands. In brief, such maps represent portions of the earth's surface, in three dimensions, by means of three co-ordinates—namely, latitude, longitude, and height above or depth below sea-level.

Professor Russell described contoured topographic maps, their advantages and uses, and enlarged upon the need of them as the basis for carrying out a wide range of enterprises. Several States, for example, ignored the fact that the results of geological surveys may be accurately laid down only upon a topographic map, with

the result that their geological work was in large part provisional and in most cases re-surveys became imperative, and thus much time and money were wasted. Speaking of the topographic survey of Michigan, he quoted Mr. C. A. Davis, who had made a preliminary study of the forest preserves of the State, and said that the existing maps, with the exception of those of small areas produced by the United States Geological Survey, were so inaccurate that they gave none of the data demanded, even for the intelligent location of a farm or a forest.

If Professor Russell's address were read by a large number of our people it would help to create the public sentiment, which is sorely needed, to influence our private map houses to improve the quality of their maps, in which respect this country now lags wofully behind all the other leading nations of the world.

Pilot Charts of the South Atlantic and South Pacific Oceans.—The monthly Pilot Charts of the North Atlantic and North Pacific Oceans, issued by the United States Hydrographic Office, are well and favourably known to seamen of all nationalities. They present, from month to month, the latest and most accurate information obtainable regarding winds, fog, ice, storm tracks, wrecks, etc., over these oceans. From year to year these charts have been improved and have become more valuable. Within a few years the British Meteorological Office began to issue similar charts for the Atlantic Ocean. Information now comes from the United States Hydrographic Office to the effect that it is proposed to publish charts of the South Atlantic and South Pacific Oceans, similar in scope to the present North Atlantic and North Pacific charts. The proposed charts will be published quarterly instead of monthly, the first to appear being the South Atlantic chart for the winter months of 1903–04, which it is hoped to have ready for distribution November 1, 1903. Successive seasonal charts of the South Atlantic will appear at quarterly intervals until the first year has been completed. Then the series for the South Pacific Ocean will be begun.

R. DeC. W.

GENERAL.

The Ninth International Geological Congress.—The next meeting of this Congress will be held on August 20–27, inclusive, in Vienna. The president of the committee in charge is Dr. Emil Tietze, Director of the Imperial Geological Office; the Secretary is Prof. Dr. C. Diener. The proceedings will include three principal

topics: 1. The present standpoint of our knowledge of crystalline schists, with papers by Profs. F. Becke, C. van Hise, P. Termier, F. E. Suess, A. Sauer, J. Sederholm, and L. Mrazec. 2. The Problem of Over-thrusts, with papers by Profs. V. Uhlig, M. Lugeon, F. Törnebohm, Bailey Willis, and F. Kossmat. 3. The Geology of the Balkan Peninsula and the Orient, with discussion by Profs. F. Toula, V. Hilber, J. Cvijic, G. v. Bukowiki, F. Katzer, and A. Philippson. Other papers of general interest and the reports of various scientific commissions are included in the programme. A number of very interesting excursions have been planned, including visits to the paleozoic region of central Bohemia, the thermal zone, and the eruptive districts of north Bohemia, the petroleum fields of Galicia, the salt regions of Salzburg, the Iron Gates of the Danube, Belgrade, and other points of interest, as well as short excursions during the sessions of the Congress to the environs of Vienna. The complete programme, with approximate estimate of the cost of excursions, may be obtained by applying to Prof. Dr. C. Diener, Vienna 1, Bartensteingasse 3 (*Petermanns Mitteilungen*, No. III, 1903).

Dr. Neumayer Retires.—Dr. G. V. Neumayer, the well-known meteorologist and geographer, on April 1 gave up the directorship of the Deutsche Seewarte at Hamburg, of which he had been in charge since 1876.

Death of Dr. Gustav Radde.—*Globus* (16, 1903) reports that Dr. Gustav Radde died at his home in Tiflis on March 16th last, in the 72nd year of his age. He was specially distinguished for his numerous contributions to the geography of animals and plants. His studies and explorations took him over a large part of north and central Asia, the Caucasus, and, to some extent, into tropical Asia. His greatest work was the founding of the Museum of Natural History, Ethnology, and Antiquities at Tiflis. He wrote a number of books, and was a frequent contributor to *Petermanns Mitteilungen* and its Supplements.

The Largest Vineyard in the World.—*La Géographie* (April, 1903), in an article on "Agricultural Economy in Portugal" by M. Ch. Flahault, prints a striking view of the largest vineyard in the world, at Poceirao. It contains 2,400 hectares (5,930 acres), on which are planted 6,000,000 vines, annually producing more than 100,000 hectolitres (about 2,650,000 gallons) of red and white wine.

NEW MAPS.

AMERICA.

PENNSYLVANIA.—General map of the Anthracite Coal Fields of Pennsylvania. Compiled by Wm. W. Ruley, Chief of Bureau of Anthracite Coal Statistics, Philadelphia. *United States Geological Survey.*

A chart showing in colours the Wyoming, Lehigh, and Schuylkill regions into which our great anthracite fields are divided; also a diagram showing the annual production of anthracite in Pennsylvania since 1820, and the amount produced by each region.

CANADA.—Manitoba. Scale, 1:792,000, or 12.5 statute miles to an inch. Department of the Interior, Ottawa. 1902.

A Land Office map showing that nearly all the southern half of Manitoba and a wide section through the northwest part of the province along the line of the Canadian Northern railroad have been subdivided by surveyors, the still unoccupied lands being thus ready for appropriation by settlers. The Land Offices, boundaries of the Land Districts, drainage features, and railroads are shown. The surprising development of railroad building in southern Manitoba has made Winnipeg a large railroad centre.

NORTHERN BOLIVIA.—Mapa de las Vias Terrestres y Fluviales que Conducen al Territorio Nacional de Colonias. Scale, 1:4,000,000, or 63.1 statute miles to an inch. Published by the Bolivian Government. La Paz. 1903.

This is a useful map, issued by Bolivia for the convenience of exploring and surveying parties and settlers in the northern and still little-known parts of Bolivia, a heavily-forested region with rich resources, particularly in rubber. It shows the Mamoré, Beni, Madre de Dios, Aquiri, and other rivers, indicating ports and limits of navigation in red and tracing in yellow the overland routes between the rivers. It includes the best delineation of the disputed Acre territory that has yet appeared. The map illustrates an official pamphlet giving all that is yet known of the geography of this region, describing its exploration, resources, conditions of navigation, climate, and method of government.

EUROPE.

MONTENEGRO.—Montenegro und sein Eisenbahnprojekt. Scale, 1:1,000,000, or 15.7 statute miles to an inch. *Deutsche Rundschau für Geographie und Statistik.*

Showing the route of the projected railroad from Niksic, in the heart of Montenegro, south to the northern corner of the Principality's short coast-line and with a branch to Cetinje.

ASIA.

ASIA MINOR.—Karte von Kleinasien. In 24 sheets. Scale 1:400,000, or 6.3 statute miles to an inch. Sheets A iv Sinob, A v Unie, B iv Jozgad, B v Siwas, C Konia, C iv Kaisarie, D iii Ermenek, and D iv Adana. By Dr. Richard Kiepert. Dietrich Reimer (Ernst Vohsen). Berlin, 1902.

These eight sheets of Dr. Kiepert's excellent map of Asia Minor mark the completion of one-third of the work. In the better-known regions elevations are shown

by brown tints. The relative value of the materials upon which the map is based is indicated by differences in drawing and lettering. The routes of many explorers are given. Dr. Kiepert is using, with great pains and critical judgment, all available material in the preparation of this very careful map, which, with corrections and additions, will undoubtedly be the standard map of Asia Minor until a detailed survey of the region is made.

LAKE CHAD.—Région du Tchad. Seven small maps of the southwestern part of Lake Chad and its Shari and Bahr el Ghazal affluents. By Captain J. Truffert. *Revue de Géographie.* June, 1903. Paris.

These maps especially illustrate the partial filling of the east portion of Lake Chad with an enormous number of long, narrow islands, all extending in a northwest and southeast direction, and owing their origin, shape, and great number to the distribution of sand and alluvium through the agency of the currents and winds.

KAMERUN.—Das Nordwestliche Grenzgebiet von Kamerun zwischen Rio-Del-Rey und Bali. By Max Moisel, after new surveys by Glauning, Ramsay, Lessner, Meyer, Strümpell, and Buthut (1900–1902), combined with earlier data. Scale 1:250,000, or 3.9 statute miles to an inch. Two sheets. *Mitteilungen von Forschungsreisenden und Gelehrten aus den Deutschen Schutzgebieten.* 1903. Berlin.

This finely-executed map gives an accurate representation of the large northwestern part of Kamerun along the German-British boundary, which has been the scene in the past two or three years of much commercial activity. It is seldom that so good a map closely follows wholly inadequate maps of the same region. It shows many important and long-known places upon the bases of accurate route surveys and astronomical place determinations; the result is that the mapped position of these places is considerably changed, Bali, for example, being assigned to 5° 53′ 18″ N. Lat. instead of 6° 30′, according to Zintgraff. The large scale permits the insertion of an unusual amount of information.

THE WORLD.

THE WORLD.—Le Réseau Mondial des Câbles Sous-Marins. Mercator Projection. *Revue de Géographie,* Paris. May, 1903.

Showing all the sub-marine cables, coloured according to the nations controlling them; also projected cables, transcontinental telegraph lines, and railroad lines that are most important in international trade.

ATLASES.

ATLAS DES COLONIES FRANÇAISES.—Dressé par ordre du Ministère des Colonies. Livraison 9. By Paul Pelet. Librairie Armand Colin. Paris.

Part 9, completing this excellent Atlas, contains 3 sheets: *Afrique Française,* on a scale of 1:14,000,000, showing north Africa as far south as the mouth of the Congo, with the boundaries of the French colonies. The routes of explorers, the railroads, and all other leading information are clearly expressed by omitting minor detail. *Colonies Françaises,* a map of the world on the equivalent projection, shows the French colonies in red, and those of all other countries in green. *Points d'Appui de la Flotte* contains 7 small maps of colonial harbours on a scale of 2:200,000, or 3.1 statute miles to an inch; and a plan of Bizerte and Goulet du Lac on a scale of 1:50,000, or 0.7 statute mile to an inch. An index, bibliography, and description of all the regions mapped accompany this last instalment of the Atlas.

SOUTH AFRICA.—The Union-Castle Atlas of South Africa. Twenty-one coloured plates, containing 36 maps and diagrams. An Index of over 6,000 names. The Union-Castle Mail Steamship Co., Ltd. London. 1903.

This is a very excellent atlas. The plates, made by George Philip & Son, Ltd., of London, are of high merit, and present a large amount of accurate information. The sheets include geologic, rainfall, physical, political, and industrial maps. This may be the first time that the three coal fields, a little south of the Zambezi, have been shown in an atlas. The Cape to Cairo railroad is now being built to the Wankie's, east of Victoria Falls, and it is expected that the superior coal found there will be widely distributed through South Africa. The political maps are coloured to show the division into counties and districts; and a particularly useful feature is the plans of the leading towns, on a large scale. The plan of Cape Town, for example, shows all the streets and the positions of principal buildings, the Botanical Gardens, parks, reservoirs, docks, and quarries. Two plates are devoted to the Witwatersrand, showing all the reefs and the names of the mines situated on them. The railroad map gives every station along the various lines. Accompanying letterpress gives an interesting account of the history, geographical features, climate, resources, game, and people of South Africa. The atlas is sold at $1, merely covering the cost of production, at the New York office of the Union-Castle Co., Nos. 8–10 Bridge Street.

NEW YORK. Geologic Map of New York of 1901. Exhibiting the Structure of the State so far as known. Scale, 5 miles to an inch. By Frederick J. H. Merrill, State Geologist, Albany, N. Y., 1903. Price, in atlas form, $3; mounted on rollers, $5.

This map succeeds the late Professor Hall's *Preliminary Geologic Map of New York State of 1894*. That map was beautifully engraved on copper, but, owing to the incompleteness of the State surveys, the errors were so numerous that it was thought best not to correct the plates for the present edition, but to issue the new map by the less expensive method of photo-lithography and leave the engraving of a new copper-plate base to the time when the topographic surveys of the State are completed; then the geologic data may be placed upon a map whose substantial accuracy is undisputed.

The geographic base of the present map is all the topographic sheets prepared up to the time of compilation and the best county maps for the remainder of the State. All the latest geologic material was brought together in the compilation of the map; but a number of the geologic boundaries are still necessarily conjectural, some because they have not yet been carefully surveyed on topographic sheets; and some because the extent of the Quaternary deposits is so great as to render these boundaries, in a large measure, indeterminate. The boundary between the Niagara and Salina formations west of the Genesee River, for example, may never be defined unless a very extensive system of borings be made. The colors and patterns used to indicate the geologic formations are, as nearly as possible, those used by the United States Geological Survey in its maps. The names applied to the formations follow closely the nomenclature employed in most of the text-books now in use, which will doubtless be a convenience to the student and teacher. Dr. Merrill, Dr. Clarke, the State paleontologist, and others who spared no effort to make this map entirely worthy of our existing knowledge and present facilities for mapping it deserve the thanks of the New York public.

Bulletin 56, of the New York State Museum, contains a description of the map, an interesting history of the New York Geologic Surveys, and a detailed acknowledgment of the material contributed by geologists for the present edition.

M. FROIDEVAUX'S PARIS LETTER.

PARIS, May 20, 1903.

To conclude the account of the Service Hydrographique de la Marine we must say something of the last four sections—that of Nautical Instructions, that of Scientific Instruments, that of Nautical Instruments, and that of Nautical Meteorology.

The Section of Nautical Instructions is charged with the publication of works intended to accompany the marine charts and to bring together all the information useful for the navigation of the coasts and for entering the channels and ports (data concerning the winds, the tides and currents, the buoyage, the pilotage, routes, resources of ports, etc.). By the help of similar documents issued by other maritime nations and selections from technical publications, the volumes of the Nautical Instructions, carefully revised to the time of publication, succeed each other as fast as possible. Side by side with these are the seven great volumes of the Lighthouse List, republished every year with the addition of carefully-registered corrections, and also the Notices to Mariners, the number of which constantly increases. Other works of this Section are the Hydrographic Annals (a collection of reports and memoirs on hydrography and navigation), the Supplements to Tables of Distances, established in 1881 and 1893; the International Code, dating from 1901; the books of Fleet Signals, etc.—all demanding the closest and the most sustained attention and toil on the part of the staff.

The Section of Scientific Instruments has devised and carried out since 1889 many improvements. It publishes, under the title of Researches on Chronometers and Nautical Instruments, papers on the use of astronomical, hydrographic, magnetic, and other scientific apparatus.

The Sixth Section, that of Nautical Instruments, introduced in 1886 a serious reform in the types adopted, beginning with the compasses and extending to the barometers, the telescopes, the micrometers, and adding the Banaré stigmograph for finding the ship's position when the compass is out of order.

The work of the Seventh Section, that of Nautical Meteorology, embraces: the digest and the publication of the meteorological records and the analysis of documents, such as log-books, meteorological registers, recorded observations, telegraphic and others, at

home and in the Colonies. This Section also examines the Four Weeks' Sheets, regularly kept on all war vessels, and epitomizes, in concert with the Central Meteorological Bureau, the contents of the registers filled out on merchant vessels according to a uniform model. It keeps monthly records of observations and publishes extracts from meteorological journals (particularly on the subject of cyclones) in the *Annales Hydrographiques*, calculations of currents, and notes on the surface temperatures of the North Pacific Ocean. These notes are intended to complete the important work on the same subject accomplished by Admiral Makaroff.

The Congress of Learned Societies held its Annual Meeting at Bordeaux, from the 16th to the 20th of April. In a study of the Currents of the Bay of Biscay, M. Bénard, President of the Oceanographical Society, reaches the conclusion that the Rennell Current does not exist, but that the current described by the Prince of Monaco and M. Hautreux enters the Bay on the north and leaves it on the southwest. M. Manley-Bendall reported progress in the preparation of the litho-biological map of the floor of this portion of the Atlantic.

M. Fabre, after an examination of the shingle, arrived at a new interpretation of various morphological peculiarities on the coast of Lower Gascony. M. Ch. Duffart, with the help of manuscript maps of Claude Masse, reconstructed the coast-line of the Landes at the beginning of the XVIII. Century, and M. Auguste Pawlowski performed a similar service for the Médoc region.

In historical geography, M. Emile Belloc read a communication on cairns and their still undetermined geographical signification, and M. l'Abbé Ricaud presented a paper on the districts included in the department of the Hautes-Pyrénées in 1790.

Dr. Giraud described the wild tribes of Upper Tonkin; M. Emile Belloc made a communication on fresh-water plankton, and M. Henri Lorin treated the Basque emigration and colonisation of French North Africa—a paper which found its complement in a note by M. Delmas on the commercial relations between Bordeaux and the western coast of Africa, exclusive of the Congo. Mention must be made of M. Marcel Charrol's studies on the anemometry of the Western Mediterranean basin and those of M. Montaudry on the meteorology of the Bay of Biscay.

Besides M. Stokes, whose address on the polar regions attracted general attention, the speakers at the meetings of the Société de Géographie have been Messrs. E. Gallois, Jean Duchesne-Fournet, A. Lacroix, and F. de Chevilly. The journey of M. Duchesne-

Fournet in Ethiopia is not to be overlooked. Starting from Jibuti, in company with Lieut. Collat, Dr. Goffin and the non-commissioned officers Fonteneau and Lahure, he passed through the desert of the Issa Somalis and the Danakil, Harar and the profound depression of the Hawash to Addis-Ababa, from which he turned to the north, reached the cañon of the Blue Nile and penetrated into Godjam. He returned to Addis-Ababa by way of Addis-Alem. The principal results obtained were a survey of Lake Tsana by theodolite, on a scale of 1:60,000, and the exploration of Koutaï (an outlier, so to speak, of Shoa, attached to the mountain-crest of the upper Metcha and Entotto).

M. Lacroix illustrated his report of his observations in Martinique with numerous photographs, showing the growth of the *lava dome*, shaped like a tooth or an obelisk, rising more than a thousand feet above the crater-edge of the Montagne Pelée. From the walls of the dome issue the *burning clouds*, formed by a mixture of steam, of ashes, and of blocks at a high temperature, which roll down to the sea, filling the ravines and carrying everything before them. M. Lacroix is the first savant who has studied these clouds, to which must be attributed the catastrophe of Saint Pierre. With a parallel between the eruptions of Martinique and Saint Vincent and the description of a discharge of mud from the volcano on the latter, M. Lacroix brought his address to a close. It is his opinion that, in view of the persistent activity of the Montagne Pelée and the continued production of the *burning clouds*, the principal destructive element, it will be necessary to prolong indefinitely the evacuation of the mountain slopes and the northern portion of the island, to which the ruin is confined. The rest of Martinique enjoys perfect tranquillity, and there is no reason to despair of its future.*

In Western Africa Messrs. Vasseur, Larcher, and Cardozo, of the Compagnie Française du Congo, have made interesting reconnaissances, a map of which, in the *Mouvement Géographique*, shows a part of the course of the Sanga and that of the Likuala, traced for the first time between Botungo, the farthest point reached by Captain Jobit in 1900, and Ebele, 40 to 45 minutes more to the north. M. Superville, administrator of Kotto, has explored the mountain mass which separates the Ubangi, the Bamingi, and the affluents of the Bangoran, and has made a map of his route on a scale of 1:250,000. The Chevalier Expedition has mapped the upper course of the Bamingi and all its eastern affluents and dis-

* M. Giraud, who accompanied M. Lacroix on his first visit to Martinique, and is now in the island, has lately expressed a similar opinion.

covered the source of most of these streams, and it brings reports of the existence of a large lake on the confines of Darfur, Dar Runga, and Wadai, called the Mamun; probably the Wadi Mamun recently mentioned on hearsay by the Russian traveller Potagos. Another lake is described as inhabited by lake-dwellers. It is in the same region that Captain Julien has continued his work of surveying the basins of the Bamingi, the Bangoran, and the Bakaré, and his reconnaissances in El Kuti and Ndele; and the members of the du Bourg de Bozas Expedition terminated their journey by surveying the course of the Welle between the confluence of the Kibali and the Dongu and Bomokandi. These gentlemen, Messrs. Brumpt, Golliez, and Didier, reached Paris on the 23d of March, and we shall learn before long the details of the work accomplished.

In Madagascar Captain Almand has made careful observations on the climate of Fianarantsoa for twenty consecutive months; and M. Paul Lemoine has studied the geology of the northern part of the island. In Asia the company charged with the construction of the railroad from Lao-kay to Yünnan-Hsien has decided to carry the road through the well-peopled valley of the northern branch of the upper Si-Kiang and by Yang-Ling.

In America Messrs. de Créqui-Montfort and Sénéchal de la Grange will make a scientific study of the Bolivian high plateaux, and this will be united with the work of Dr. Rivet, of the Geodetic Expedition in Ecuador.

Dr. Charcot's intended Arctic voyage, announced in my last letter, has been abandoned, in deference to the wishes of his patrons, and he will set out for the Antarctic. From Tierra del Fuego he will endeavour to reach Alexander I. Land, and will devote himself, in the sector comprised between 65° and 160° of longitude, to scientific researches bearing upon oceanography, geography, and zoology, and completing, in this way, the investment of the Antarctic, where the English are at work in Victoria Land, the Germans near Kemp and Enderby, the Swedes near Louis-Philippe Land and Gerlache Strait, and the Scots in the Weddell Sea. In the region of Alexander I. Land everything has yet to be discovered; and it may be hoped that Dr. Charcot's expedition will be fruitful in results. The presence of M. de Gerlache on board the *Pourquoi Pas?* is a happy augury; and if France still remains indifferent to Arctic enterprise, there is reason to rejoice that the heritage of Bouvet and Kerguélen and Dumont d'Urville is in good hands.

Among the many works of a geographical nature published in the last two months, considerable importance is to be attached to

M. Vidal de la Blache's Introduction to the History of France, issued under the direction of M. E. Lavisse. This Introduction merits a separate notice at a later day.

Something must be said of M. Lugeon's study of the Alps of Chablais and Switzerland—a study which tends to the overthrow of the accepted theories as to the formation of the Alps. According to M. Lugeon, the Alps must be regarded as deposits, transported a distance of fifty miles from the south on the inner line of the Alpine curve, in the zone of the amphibolites of Ivrea. This hypothesis is not more bold than seductive, since it enables us to group the majority of the known facts and to arrange them in an orderly succession, and marks a real advance on the theory of fan-like diverging folds.

A work by M. de Mathuisieulx, *À Travers la Tripolitaine*, is a contribution to the knowledge of a country made difficult of access by the Turkish authorities. The *Voyages au Maroc* of the Marquis de Segonzac is the record of journeys accomplished at the risk of his life, in the years 1899–1901. The book is divided into two parts: one tells the story of the author's excursions in the Rif, among the Djebala and the Braber and in the Sus; the other presents, systematically arranged by competent specialists, all the scientific information gathered, with a geographical notice by M. René de Flotte Roquevaire, the cartographical authority for this portion of North Africa and author of the excellent map, on a scale of 1:2,000,000, which accompanies the *Voyages*. There are also nine detailed maps of itineraries, on a scale of 1:250,000, and plates of sketches and profiles (separately published by Barrère). Not to be overlooked are two monographs, small, but of real value: that of M. Lacroix on the *Derkaoua*,* *Yesterday and To-Day*, and those of Dr. Huguet on the *Jews of the Mzab* and on *The Tuareg*.

In the *Renseignements Coloniaux et Documents* for May, the Comité de l'Afrique Française has finished the account of M. Thomann's journey from the Ivory Coast to the French Sudan, in 1901–1902, and gives a map of the basin of the Sassandra, on the scale of 1:500,000.

Another map of special importance is that brought out by Commandant Baratier, under the auspices of the Société de Géographie, showing, on a scale of 1: 1,000,000, the route of the Marchand Expedition from the upper Ubangi to Jibuti, across the basins of the

* The Derkaoua are a religious brotherhood whose doctrines enforce abstinence from every earthly ambition and an absolute detachment from the concerns of this world.

Bahr el Ghazal and the Nile, and Ethiopia. It must be regretted that this valuable map does not give the complete line of march followed by the Bonchamp party. When are we to see the account of the journey?

I must not close without noting the appearance of Dr. E. T. Hamy's Fifth and Sixth Decades of Memoirs of American Archæology and Ethnography, published under the title of *Decades Americanæ.*

HENRI FROIDEVAUX.

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MAY–JUNE, 1903.

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THE NEW PORT OF VERA CRUZ.

The accompanying map shows the improvements which have converted Vera Cruz into a safe harbour. Those who knew the sea front of the city a few years ago would scarcely recognize it to-day.

Vera Cruz has always been the chief port of Mexico. In the fiscal year 1900–01, 338 vessels from foreign ports entered the harbour. Their tonnage was 913,698, and they carried 355,930 metric

tons of freight. The value of the imports in that year in Mexican dollars was $22,349,788; and of the exports, $21,954,876. While doing this large business, Vera Cruz in its shipping facilities was one of the poorest ports in America. Large vessels were not able to reach the small stone pier projecting into the roadstead. Their cargoes were taken to the land by lighters. There was no protection against the storms of the Gulf. During the season of hurricanes every sailing vessel which cast anchor in front of the town did so at the peril of life and cargo. Every steamer kept up steam ready to put to sea at the first sign of dirty weather. In a single year thirteen vessels dragged their anchors and were dashed to pieces on the rocks.

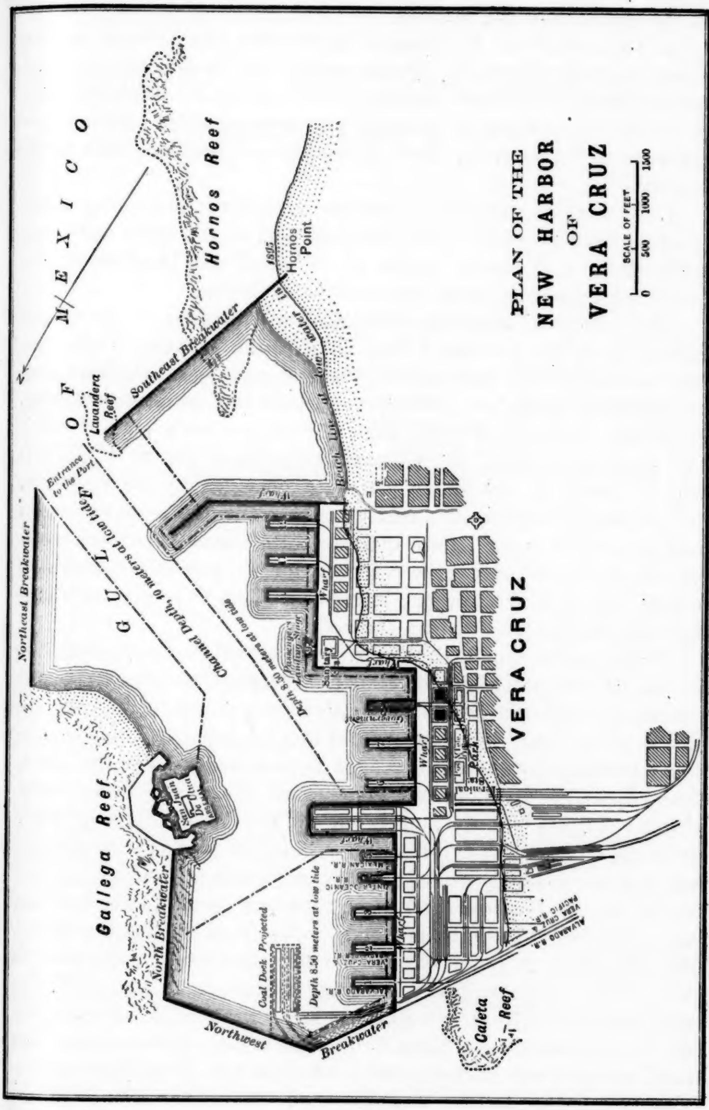
The results of these disadvantages were excessive charges for freight and insurance and continued disquietude of mind among shipowners, merchants, and sailors. All this has been changed by the conversion of Vera Cruz into a first-class artificial port, equal to any in the world, and equipped with every modern facility. The new port was opened by President Diaz on March 6, 1902.

The work cost about $30,000,000. The problem was to convert the open roadstead into a protected harbour by means of artificial defenses combined with natural features. The natural features were the coral reefs partly encircling the bay, which previously had been chiefly a danger, but were now made to subserve the plan for the protection of the harbour.

The reefs were, on the north, La Caleta, near the shore, and La Gallega, 600 metres out in the Gulf; and on the south the Hornos, near the shore, and the Lavandera, about 320 metres out. The Gallega reef is the most extensive, stretching opposite the city for a distance of 1,200 metres. These reefs form a sort of bay, 2,000 metres wide. The bay was completely exposed to the north and northeast winds. When a heavy norther blew, the waters of the Gulf were driven with great violence through the narrow passage between the Caleta and Gallega reefs. Any plan for improving the port involved the closing up of the north entrance to the harbour between these two reefs. This and much more was done, as is shown in the following enumeration of the exterior protective works:

1. The northwest breakwater, extending from the Caleta reef across the bay to the Gallega reef, closing the old north entrance to the port and affording the chief protection against the north wind.

2. The north wall (previously built) joining the foregoing with the Island of Ulua.


PLAN OF THE
NEW HARBOR
OF
VERA CRUZ
SCALE OF FEET
0 500 1000 1500
GULF OF MEXICO
Hornos Reef
Hornos Point
Southeast Breakwater
Lavandera Reef
Entrance to the Port
Northeast Breakwater
Channel Depth, 10 meters at low tide
Depth 8.50 meters at low tide
Gallega Reef
North Breakwater
Northwest Breakwater
Coal Dock Projected
VERA CRUZ
Caleta Reef
Wharf

3. The northeast breakwater, extending from the Gallega reef to the entrance of the harbour.

4. The southeast breakwater, protecting the harbour on the south, extending from the Hornos reef to the Lavandera reef, and leaving between its outer extremity and the outer extremity of the northeast breakwater a channel 260 metres wide, forming the entrance to the harbour. Both extremities are provided with lighthouses.

5. As a further measure of defense against the prevailing south wind an inner protective wall, forming part of the town quay, was built about a kilometre inside of the southeast breakwater, the space between them being reserved for anchorage.

The town quay was built in the sea, at a distance of about 400 metres from the low-water line. The space between it and the land was filled with sand, and buildings are rising on the land thus reclaimed from the sea. The piers for shipping, as is shown on the map, were extended at right angles from the town quay. One is the fiscal pier, where the Customs business of the port is transacted. Some of the other piers are occupied by the railroads, freight being transferred directly between the cars and the vessels tied up at the piers. Two spacious warehouses have been completed, and sites have been reserved for an indefinite number of others. Thus, to the shipping interests of Vera Cruz greater wharfage and storage facilities are assured.

These improvements, however, were not all that was needed to enable the city to enjoy the prosperity to which its commercial preeminence entitles it. It is imperatively necessary to improve the health of the city. It is almost fatal to a large port if ships leaving it are persistently quarantined upon their arrival at foreign ports. The city had no good sewage system, and its water was not fit to drink. To this fact was largely due the terrible yellow fever which gave the city such an evil reputation. For the past year new sewerage and water-supply works have been rapidly advancing. These works are of the best and most thorough kind. Pure drinking water will be obtained by pumping works from the Jamapa River, and will afford an ample supply for twice the present population of Vera Cruz. The improved sewerage system is far advanced, and will have a total length of about 55 kilometres. It is expected that the transformation of Vera Cruz into a safe, commodious, and healthful port will stimulate the trade relations of Mexico with foreign countries, increase business, and add to the wealth of the Republic.

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JUNE 30, 1903.

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1881 *Baldwin, Edwin.*
1882 Baldwin, Octavius D.
1874 *Baldwin, Townsend B.*
1899 Baldwin, William D.
1901 *Ballantine, Robert F.*
1888 *Bancroft, H. H.*
1884 Bangs, Fletcher H.
1868 *Banks, David.*
1880 *Banks, D. S.*
1869 Banyer, Goldsboro.
1891 Barber, Amzi L.
1887 *Barbey, Henry I.*
1882 *Barger, Samuel F.*
1889 Baring, Thomas.
1886 *Barker, P. C., M.D.*
1890 Barnard, John F.
1901 Barnard, John H.
1898 Barnes, Chas. J.
1874 Barnes, John S.
1882 Barney, N. C.
1902 Barr, Edward.
1874 Barr, William.
1887 *Barron, John C., M.D.*
1888 Barstow, J. Whitney, M.D.
1878 *Barton, Oliver Grant.*
1899 *Bartow, Charles S.*
1898 Batchelor, Charles.
1903 Batchelor, Joseph C.

Date of Election.

1899 Beach, Rev. Harlan P.
1895 Beal, William R.
1901 Beckley, John N.
1886 Beddall, Edward F.
1875 Beekman, Gerard.
1888 Beers, M. H.
1874 Belding, Milo M., Sr.
1897 Belding, Milo M., Jr.
1891 Belin, Henry, Jr.
1901 Belknap, Henry.
1900 Bell, Alexander Graham.
1900 *Bell, Bertrand F.*
1897 Bell, Dr. Ralcy H.
1883 Bell, Capt. William R.
1890 Benedict, James H.
1897 Benjamin, Morris W.
1868 Bennett, James Gordon.
1883 Benson, Frank Sherman.
1890 Bergen, James C.
1891 Bernheim, Gustav.
1903 Bernheimer, Charles L.
1890 Bertschmann, J.
1886 Berwind, Edward J.
1891 Besly, Chas. Howard.
1875 Besté, Henry.
1869 Bickmore, Prof. A. S.
1897 Biddle, Anthony J. Drexel,
1889 Biddle, Edward R.
1895 Bien, Joseph R.
1874 Bien, Julius.
1903 Bigelow, Frank G.
1889 *Bigelow, Poultney.*
1887 *Biglow, Lucius H.*
1891 Bogue, Virgil G.
1903 Binney, Harold.
1897 Billings, Frederick.
1893 Birdsall, Mrs. W. R.
1887 Blagden, George.
1898 Blake, Theodore A.
1900 Blinn, F. Gray, M.D.
1878 *Bliss, Cornelius N.*
1890 *Bliss, D. L.*
1901 Bliss, William H.
1897 Blodgett, Mrs. William T.
1895 Boas, Emil L.
1888 Bogert, S. G.
1891 Boies, H. M.
1886 Bond, Frank S.
1884 *Bonner, G. T.*
1874 Bookstaver, Henry W.

Date of Election.

1899 Booraem, John V. V.
1859 *Boorman, J. Marcus.*
1897 Booth-Tucker, Frederick de L.
1900 Bormay, W. J.
1899 Botsford, Elmer F.
1901 Bouker, Le Grand.
1903 Bourne, Charles Griswold.
1886 Bouvier, M. C.
1902 *Bowditch, Charles P.*
1900 *Bowdoin, George S.*
1886 Bowers, John M.
1883 *Bowne, Walter.*
1890 *Boyd, John Scott.*
1890 *Brackenridge, George W.*
1897 Bradley, Charles W.
1895 Bradley, Edson.
1897 *Brainard, Lt.-Col. David L., U. S. A.*
1899 Brett, George P.,
1890 Brewster, C. O.
1902 *Brewster, Robert S.*
1886 Bridgman, E. C.
1900 Bridgman, Herbert L.
1903 Brizse, Charles N.
1889 *Bromberg, Frederick G.*
1902 Brooke, Charles F.
1890 Brooker, Chas. F.
1897 Brooks, George G.
1886 *Brown, Addison.*
1901 Brown, Alexander, Jr.
1903 Brown, Benjamin D.
1903 Brown, F. Q.
1878 Brown, J. Romaine.
1878 Brown, Rev. Philip A. H.
1887 *Brown, Robert I.*
1899 Browne, Aldis B.
1875 Brownell, Silas B.
1874 *Brownson, Commander W. H., U. S. N.*
1901 *Bruce, Miss Matilda W.*
1901 *Bruce-Brown, William.*
1901 Bruguière, Louis Sather.
1902 *Buchanan, James Isaac.*
1900 Bulkley, Justus L.
1903 *Bunker, George R.*
1897 Burdge, Franklin.
1898 Burr, William H.
1902 *Burrage, Albert C.*
1902 *Burrage, Albert C., Jr.*
1902 *Burrage, Francis H.*

Date of Election.

1902 *Burrage, Russell.*
1903 Burton, Prof. A. E.
1899 Busby, Leonard J.
1890 Bushnell, Joseph.
1902 Butes, Alfred.
1895 Butler, Joseph G., Jr.

1888 Canda, Charles J.
1887 Cannon, H. W.
1884 Carey, Henry T.
1894 Carey, William Francis.
1900 Carleton, Dr. Edmund.
1898 Carmalt, Dr. W. H.
1901 *Carnegie, George L.*
1886 *Carter, Henry C.*
1889 *Carter, John J.*
1895 Carter, Walter S.
1897 Cassard, William J.
1899 Chase, George A.
1897 Chamberlain, Rev. John.
1897 Chamberlain, Rev. Leander T.
1899 Chambers, Arthur D.
1897 Chambers, Frank R.
1899 Chambers, Frederick F.
1890 Chanler, William Astor.
1897 *Chapin, Chester W.*
1901 Chapin, E. P.
1883 *Chapman, Henry E.*
1868 Chapman, Joseph H.
1888 Chase, George.
1901 Chase, Dr. Walter G.
1886 *Chauncey, Elihu.*
1899 Chisholm, Hugh J.
1888 Chisolm, George E.
1886 Church, Benjamin S.
1902 *Church, Duane H.*
1874 *Church, Col. George Earl.*
1897 Church, George H.
1884 *Claflin, John.*
1891 Clapp, George H.
1889 Clark, Charles F.
1887 Clark, Jefferson.
1901 Clark, W. A.
1886 Clarke, C. C.
1882 *Clarkson, Banyer.*
1889 Clausen, George C.
1883 Clews, Henry.
1883 Clyde, William P.
1890 Cockcroft, Miss Mary T.
1897 Coffin, C. A.

Date of Election.

1886 Coffin, Edmund.
1891 Cogswell, W. B.
1891 Cohen, Samuel M.
1900 Cole, Edward H.
1901 Cole, George Watson.
1888 Coleman, James S.
1888 Colgate, Abner W.
1874 Colgate, James B.
1898 Collier, M. Dwight.
1893 *Colvin, Verplanck.*
1897 Combe, Mrs. William.
1892 Comer, John H.
1897 *Comstock, Frederick H.*
1889 Comstock, George Carlton.
1899 Condon, Thomas G.
1886 Conger, Clarence R.
1882 Conkling, N. W., D.D.
1884 *Connor, W. E.*
1874 *Conyngham, William L.*
1902 *Constable, Frederick A.*
1898 Cook, Eugene B.
1894 Cook, Dr. Frederick A.
1888 Cook, Henry H.
1893 Coolidge, J. Randolph.
1856 Cooper, Edward.
1903 Cornell, Russell R.
1902 Corning, C. R.
1897 Corning, G. M.
1886 Corthell, Elmer L.
1902 Cotton, Louis K.
1882 Coudert, F. R., LL.D.
1888 *Coutan, Charles Albert.*
1898 Cox, A. Beekman.
1899 *Cox, John Lyman.*
1902 *Coxe, Eckley B., Jr.*
1889 *Coxe, Henry B.*
1901 *Crain, Dunham Jones.*
1902 Cramp, Charles H.
1889 *Crane, Charles R.*
1902 *Crane, Zenas.*
1887 *Cranitch, William I. A.*
1900 Crawford, C. G.
1888 Crimmins, John D.
1899 Crimmins, T. E.
1874 Crocker, George A.
1874 Crosby, J. Schuyler.
1901 *Crozier, Capt. William.*
1903 Cumnock, Victor I.
1901 Curran, James.
1898 Curtis, Osborn Marcus.

Date of Election.

1901 *Curtis, William Edmond.*

1889 Daley, George H.
1884 Dalley, Henry.
1871 Daly, Joseph F.
1901 Dana, Samuel B.
1903 Dana, William B.
1895 Daniels, Charles H.
1892 Daniels, W. L.
1888 *Davenport, Ira.*
1898 Davidson, James W.
1875 Davies, Julien T.
1884 Davis, Howland.
1877 *Davis, Joseph Beale.*
1901 Dawson, Miles Menander.
1880 *Deane, John H.*
1892 DeBuys, A.
1883 Decker, Joseph S.
1901 de Coppet, Henry.
1880 *Deen, William M.*
1895 De Kalb, Courtenay.
1900 *Delafield, Albert.*
1874 Delafield, M. L.
1886 *de Lancey, Edward F.*
1897 Delbridge, Charles L.
1903 de Lemos, Theodore W. E.
1890 Dellinger, Charles F.
1901 Dennis, Rev. James S.
1899 Dennis, John B.
1899 Dennis, Rodney S.
1901 Dennis, Samuel S.
1875 *de Peyster, Frederic J.*
1874 *de Peyster, Gen. J. Watts.*
1880 *Dexter, Henry.*
1894 Dieterich, Charles F.
1897 Dillingham, Edwin R.
1890 *Dinsmore, C. Gray.*
1899 Diven, George M.
1886 Dix, Morgan, D.D.
1881 *Docharty, Augustus T.*
1889 Dodd, S. C. T.
1897 Dodge, Rev. D. Stuart.
1903 Dodge, Gen. Grenville M.
1896 Dodge, Richard E.
1901 Dodge, Walter Phelps.
1856 Dodge, William E.
1893 Dodson, Robert Bowman.
1875 Dommerich, L. F.
1889 *Donald, Peter.*
1903 Donovan, John J.

Date of Election.

1899 Doremus, Robert P.
1897 Doughty, Mrs. Alla.
1884 *Douglas, James.*
1903 Douglass, R. D.
1888 *Drexel, Mrs. Joseph W.*
1891 Drey, Max.
1880 Du Bois, Frederick W.
1874 *Du Bois, William A.*
1898 Dunham, Edward K., M.D.
1897 Dunnell, William N., D.D.
1897 Dunscomb, S. Whitney, Jr.
1889 Du Pont, Col. H. A.
1885 *Dupré, Ovide.*
1901 *Durand, John S.*
1889 Durkee, Eugene W.
1894 Duvall, William C.
1889 Dwight, Jonathan, Jr., M.D.

1882 *Earle, Joseph P.*
1886 *Easton, Robert T. B.*
1902 Eberstadt, Edward F.
1880 Eckert, Gen. Thomas T.
1882 Edwards, J. Pierrepont.
1887 Egleston, Melville.
1897 Eimer, August.
1901 *Eldert, Cornelius.*
1901 *Eldridge, Lewis A.*
1900 Eldridge, Roswell.
1887 Elkins, S. B.
1879 *Elliott, Samuel.*
1886 Ellis, George W.
1875 Ellis, John W.
1882 *Ellis, Wilbur Dixon.*
1903 Ellis, William H.
1897 Ellison, John E.
1900 Embury, Aymar.
1882 *Emerson, John W.*
1868 Emmet, Thomas Addis, M.D.
1903 Endicott, William C.
1883 Eno, Amos F.
1903 Eskeson, Eckhardt V.
1891 Eustis, W. E. C.
1891 Eyerman, John.

1901 Fahys, George E.
1882 Fairbanks, Leland.
1890 Fairchild, Chas. S.
1892 Fairchild, Samuel W.
1902 Fairleigh, David W.
1875 Fargo, James C.

Date of Election.

1901 *Farnsworth, William.*
1896 Farquhar, Edward Y.
1874 Farragut, Loyall.
1903 Faulkner, Charles J.
1901 Faust, John Armstrong.
1890 *Fearing, Daniel B.*
1898 Fearons, Geo. H.
1898 *Ferguson, Henry.*
1888 *Ferguson, Walton.*
1900 Fischer, Emil S.
1901 Fischer-Hansen, Carl.
1902 Fisk, Harvey Edward.
1902 Fisk, Pliny.
1903 Fitzgerald, Frank T.
1886 *Flagler, H. M.*
1871 Fliess, Wm. M.
1889 Flint, Chas. R.
1901 *Flower, Anson R.*
1901 *Flower, Frederick S.*
1875 Folsom, George W.
1875 *Ford, James B.*
1901 Fowler, Jonathan Odell, Jr.
1894 Fox, Andrew Jackson, M.D.
1874 *Fox, Austen G.*
1884 Frazer, Alfred.
1894 Frazer, Horatio N.
1873 Freedman, John J.
1889 Freeland, Theodore H.
1894 Frick, John.
1902 Frissel, A. S.
1875 Fuller, Charles D.
1901 Fulton, E. M., Jr.

1898 Gadd, Luther G.
1903 *Gaff, Thomas T.*
1889 *Gage, E. B.*
1886 Gallatin, Frederic.
1897 Garver, John A.
1903 *Gates, Isaac E.*
1891 Gay, Edward.
1879 Gay, Joseph E.
1868 *Gebhard, William H.*
1903 Gerdau, Otto.
1900 Gerhard, William Paul, C.E.
1868 *Gerry, Elbridge T.*
1889 *Gest, Erasmus.*
1894 Gherardi, Bancroft, Rear Adm. U. S. N.
1897 Gibbs, Frederick S.
1894 Gibbs, John Wilson, M.D.

Date of Election.

1874 *Gibbs, Theodore K.*
1903 Gibney, John R.
1899 Gibney, Dr. V. P.
1901 *Gilbert, Clinton.*
1889 Gilbert, G. K.
1893 *Gilbert, J. H. Grenville.*
1903 Gilman, Theodore P.
1885 Glazier, Simon W.
1897 Gleason, John J.
1897 Golding, John Noble.
1903 Goldman, Albert.
1898 *Goodnow, Harold P.*
1900 Goodridge, F. G., M.D.
1898 Goodwin, Rev. Francis.
1886 *Goodwin, James J.*
1887 Gossler, Gustav H.
1887 Gould, George J.
1881 *Grace, William R.*
1899 Grant, F. E.
1879 *Graves, Arthur B.*
1895 Greeff, Ernest F.
1868 Green, Andrew H.
1897 Green, Frederick V.
1901 Green, Pinckney F.
1898 Green, Samuel Swett.
1891 Greene, David M.
1898 Greene, Jacob L.
1883 *Greenough, John.*
1892 Greenwood, Langdon, Jr.
1897 Grossmann, Ignatius R.
1887 *Grosvenor, James B. M.*
1897 Gruber, Abraham.
1897 Gunther, Charles B.
1886 *Gunther, Franklin L.*
1891 Haas, Kalman.
1869 *Hadden, John A.*
1897 Hagerman, G. E.
1887 Hague, James D.
1874 *Haines, John P.*
1901 Hall, Rev. Dr. Charles Cuthbert.
1868 Hall, Elial F.
1903 Hamilton, Edmond H.
1879 Hamilton, William Gaston.
1901 Hand, Learned.
1888 Harbeck, Charles T.
1888 Hard, Anson W.
1901 Hardie, Wainwright.
1900 Harding, Edward.
1900 Hardley, J. Wheeler.
1902 Hare, J. Knowles.

Date of Election.

1903 Harrison, Hugh H.
1897 Hart, Walter T.
1903 Harvey, Miss Rebecca.
1882 Hascall, Theodore F.
1887 Hastings, Thomas S., D.D.
1889 Hastings, W.
1859 *Havemeyer, John C.*
1902 *Havemeyer, William F.*
1894 Haven, J. Woodward.
1887 Hayes, Richard Somers.
1889 Haynes, Henry W.
1891 Hazard, Frederick R.
1898 *Hearn, Arthur H.*
1897 *Hearn, George A.*
1883 *Hebert, Henry B.*
1902 Hedge, Frederic H.
1897 Heike, C. R.
1903 Heimann, Julius.
1897 Heinsheimer, L. A.
1902 Henderson, Charles R.
1886 Henderson, Harold G.
1874 Hendricks, Edmund.
1901 Hentz, Henry.
1899 *Herbert, John W.*
1891 Herrman, Abraham.
1903 Herrmann, George.
1903 Herrmann, Nathan.
1900 Herzog, F. Benedict, Ph.D.
1903 *Hewitt, Peter Cooper.*
1900 Hewlett, Walter Jones.
1901 Heydt, Herman A.
1882 *Higginson, James J.*
1894 Hildreth, J. Homer.
1903 Hill, Charles B.
1890 Hill, James J.
1886 Hillhouse, Thomas G.
1887 Hinchman, Walter.
1899 Hinkley, James W.
1881 Hinman, Russell.
1878 Hinman, William K.
1874 *Hinton, John H., M.D.*
1903 *Hirsch, Robert B.*
1889 *Hitchcock, Welcome G.*
1903 Hobbs, Edward H.
1903 Hodgman, George F.
1898 Hodgson, Richard, LL.D.
1886 Hoe, Robert.
1897 Hoe, William A.
1876 Hoes, William M.
1897 Hoey, Rev. Joseph L.

Date of Election.

1901 Hoffman, Charles F., Jr.
1872 *Holbrook, Levi.*
1893 Holls, Frederick William.
1898 Holmes, George.
1876 Holt, Henry.
1902 Holton, Henry D.
1901 *Hopkins, George B.*
1896 Hoppin, Hamilton L.
1898 Hoppin, James M., D.D.
1897 Hoppin, Samuel Howland.
1896 Hotchkiss, Miss C. W.
1898 Howell, M. D.
1888 *Hoyt, Henry R.*
1898 *Hubbard, Robert J.*
1901 *Hubbard, Thomas H.*
1885 Hubbard, Walter.
1900 Hudnut, Richard A.
1897 Humphreys, Alexander C., C.E.
1903 Humphreys, Edward W.
1887 Hunker, J. J., Com'd'r U. S. N.
1893 *Huntington, Archer M.*
1868 *Huntington, Daniel.*
1893 Hurlbut, Theodore D.
1898 Hurley, Thomas J.
1883 *Hurry, Edmund Abdy.*
1889 *Hurtt, Frank D.*
1890 Husted, Seymour L., Jr.
1895 *Hutchinson, Charles Hare.*
1897 Huyler, John S.
1901 Hyde, Augustus L.
1892 *Hyde, Clarence M.*
1883 Hyde, E. Francis.
1897 Hyde, Dr. Frederick E.
1901 *Hyde, James H.*

1899 Insull, Samuel.
1899 Ireland, J. de Courcy.
1859 Ireland, John B.
1890 Irving, Walter.
1874 Iselin, Adrian, Jr.
1887 *Isham, Charles.*
1881 *Ives, Brayton.*
1903 *Ives, Frederick D.*

1903 Jackson, A. Wendell.
1886 *Jackson, Rev. Samuel M.*
1897 Jackson, Theodore F.
1886 Jacobi, Abraham, M.D.
1902 Jacobs, Henry Barton, M.D.
1891 Jaffray, Robert, Jr.

Date of Election.

1894 James, Arthur Curtiss.
1874 James, D. Willis.
1890 James, Walter B., M.D.
1886 Janeway, Henry L.
1890 Janin, Henry.
1891 Jaques, W. H.
1903 Jarvie, James N.
1879 Jay, William.
1887 Jenkins, Augustus S.
1893 Jenkins, Michael.
1874 Jenkins, William L.
1903 Jennings, Abraham Gould.
1895 Jennings, Oliver G.
1902 Jessup, Henry W.
1874 *Jesup, Morris K.*
1880 *Jewett, George L.*
1881 Johnson, Bradish.
1901 Johnson, Edward C.
1893 Johnson, Reverdy.
1888 *Jones, Oliver L.*
1871 Jones, Walter R. T.
1891 Jones, Washington.
1897 Judson, Rev. Edward.
1885 Juilliard, A. D.
1901 Julian-James, Mrs. Cassie.

1898 Kahn, O. H.
1881 *Kane, Grenville.*
1893 *Kane, Henry Brevoort.*
1879 Kane, S. Nicholson.
1895 *Kean, Hamilton F.*
1874 Keck, Thomas.
1880 *Keene, James R.*
1888 Kellogg, Charles.
1897 Kemmerer, M. S.
1903 Kemp, James Furman.
1873 *Kennan, George.*
1901 Kennedy, E. G.
1901 *Kennedy, George G., M.D.*
1888 Kennedy, H. Van Rensselaer.
1881 *Kennedy, John S.*
1901 Kent, William.
1885 *Keppler, Rudolph.*
1878 *Kernochan, James Lorillard.*
1903 Kerr, John B.
1883 Kerr, Walter.
1901 *Ketchum, Alexander P.*
1887 Kevan, William.
1886 *Kidder, Camillus G.*
1901 Kidder, James H.

Date of Election.

1897 Kimball, Alfred R.
1889 *Kimball, F. J.*
1883 King, D. H., Jr.
1874 King, Edward.
1902 *King, Mrs. Edward.*
1882 *King, George Gordon.*
1892 King, John Hurtin.
1874 *Kingsland, William M.*
1901 Kirby, Thomas E.
1881 Kirsch, Louis.
1888 Kissel, Gustav E.
1891 Kissel, Rudolph H.
1899 Knight, D. Allen.
1887 *Knight, George T.*
1901 Kohlman, Charles.
1897 Kohn, S. H.
1901 Kohnstamm, Emil V.

1890 Lamberton, Charles L.
1895 Landon, Francis G.
1898 Lane, Wolcott G.
1882 Langdon, Woodbury.
1881 *Langdon, Woodbury G.*
1882 Lapham, Lewis H.
1897 Larrabee, Jesse.
1859 *Lathers, Richard.*
1902 Laughlin, Harry H.
1901 Lawrence, Arthur, D.D.
1897 Lawrence, Cyrus J.
1892 Lawrence, E. A.
1902 Lawrence, John Burling.
1903 Lawson, Victor F.
1901 Lawson, William.
1893 Learned, William L.
1886 Leete, C. H.
1900 Le Gendre, William C.
1900 *Leggett, Francis H.*
1903 Lehmaier, James M.
1903 Lesher, Arthur L.
1901 *Leupp, William H.*
1902 Leverich, S. Duncan.
1891 Levine, Julius.
1896 *Lewis, Clarence McK.*
1902 Lewis, Rev. William G. W.
1881 *Libbey, Prof. William.*
1903 Lincoln, Lowell.
1898 Lincoln, Solomon.
1902 Linderman, Garrett B.
1899 *Lippincott, Henry H.*
1903 Lisman, Frederick J.

Date of Election.

1881 *Little, Joseph J.*
1897 *Livingston, Goodhue.*
1897 Lobenstine, William C.
1901 Lockman, Myron A.
1902 Lockwood, Hanford N.
1900 Loeb, Morris.
1870 *Loew, Frederick W.*
1891 Loewy, Benno.
1887 Logan, Walter S.
1897 Long, Thomas J.
1901 Lord, Austin W.
1903 *Lorillard, Pierre.*
1890 *Loth, Joseph.*
1878 *Loubat, J. F., LL.D.*
1883 Lounsbery, R. P.
1876 *Low, A. Augustus.*
1875 *Low, Seth, LL.D.*
1903 Low, William G.
1898 Lowenstein, B.
1886 *Ludington, Charles H.*
1899 Luttgen, Walther.
1889 Lydig, David.
1900 Lyman, Frank.
1888 *Lynch, James D.*

1900 M'Caleb, Thomas.
1898 McAlan, John.
1903 McConnell, Samuel P.
1895 *McCord, William H.*
1902 McCormac, G. J.
1887 McCready, N. L.
1897 McDonald, John E.
1903 McDougall, Walter.
1901 McFarlane, C. T.
1902 McGraw, F. S.
1897 McKeen, James.
1888 McKeever, J. Lawrence.
1898 McLean, Donald.
1895 McMillin, Emerson.
1903 McWilliams, Daniel W.
1903 Maas, Gustavus.
1896 MacCoun, Townsend.
1887 Mack, J. W.
1903 *Mackay, Clarence H.*
1883 *Mackay, Donald.*
1884 *MacKellar, William.*
1890 Mackey, Charles W.
1898 MacKie, Charles Paul.
1898 MacKie, James Steuart.
1901 Macy, George H.

Date of Election.

1901 *Macy, V. Everit.*
1898 Magerhans, Adolph W.
1899 Mahl, William.
1889 *Maitland, Alexander.*
1887 Malcolm, William L.
1902 Mandeville, H. C.
1903 Mann, William D'Alton.
1874 Marble, Manton.
1897 Marc, Theophilus M.
1875 Marcus, Arnold.
1895 Marcus, George E.
1882 *Markoe, Francis H., M.D.*
1888 *Marquand, Henry.*
1898 Marsh, Joseph A.
1901 Marshall, Charles H.
1897 *Marshall, Louis.*
1898 Marston, Edwin S.
1875 *Martin, Bradley.*
1888 *Martin, Oswald J.*
1889 Martin, Robert C.
1888 *Mason, Alexander T.*
1901 Mather, Samuel.
1901 Matthews, Albert.
1899 Matthews, George E.
1902 Matthews, M. A., D.D.
1903 Maxwell, Francis Taylor.
1901 Maxwell, Robert.
1901 Maxwell, William H.
1891 Meeks, Edwin B.
1902 *Mellen, Charles S.*
1903 Mellon, Charles H.
1874 *Merrall, William J.*
1897 Merrill, William F.
1901 Meyer, Harry H.
1897 Millar, George W.
1901 *Miller, Dr. George N.*
1892 Miller, Warner.
1892 *Mills, A. G.*
1880 *Mills, Darius O.*
1875 Mitchell, Edward.
1899 Mitchell, John Murray.
1876 Mitchell, W. Howard.
1902 Monks, John, Jr.
1890 Montant, Alphonse.
1901 Montgomery, F. Warren,
1901 Montgomery, Harry E.
1859 *Moore, Frank.*
1884 *Moore, Joseph, Jr.*
1863 *Moore, W. H. H.*
1883 Morgan, E. D.

Date of Election.

1874 *Morgan, J. Pierpont.*
1901 *Morgan, J. P., Jr.*
1887 *Morgan, William Fellowes.*
1889 Morgan, William H.
1885 *Morison, George S.*
1859 *Morrell, W. H.*
1900 Morris, Fordham.
1874 *Morris, Henry Lewis.*
1903 Morris, John.
1898 *Morris, Newbold.*
1897 Morris, Robert T., M.D.
1902 *Mortimer, Rev. Dr. Alfred G.*
1864 *Morton, Levi P.*
1900 Moses, Theodore W.
1898 Moss, Charles H.
1888 Moss, Mrs. J. Osborne.
1897 Muller, Edward M.
1897 Murray, David.
1888 Myers, Theodore W.
1901 Myers, Mrs. Theodorus Bailey.

1895 Nason, Carleton W.
1901 Neeser, John G.
1886 *Neftel, William B., M.D.*
1893 Nelson, E. B.
1880 Nelson, William.
1891 Neukirch, Chas.
1897 Nevers, George G.
1899 Newbold, Clement Buckley.
1897 *Newell, F. H.*
1891 *Newman, Mrs. Angeline Ensign.*
1899 Newton, James S.
1902 Nichols, Francis H.
1897 Nichols, George L.
1892 Nichols, O. F.
1902 Nicolas, Louis J.
1899 Nimmo, Joseph, Jr.
1897 Nixon, Lewis.
1897 Notman, George.
1886 Notman, John.
1902 Noyes, Daniel Rogers.
1889 Nunn, R. J., M.D.

1888 *Oakes, T. F.*
1898 Obermeyer, Joseph.
1879 *O'Brien, Thomas S.*
1903 O'Connor, Harry L.
1901 O'Connor, Nicholas R.
1875 *O'Connor, Thomas H.*
1903 O'Donohue, Joseph J., Jr.

Date of Election.

1887 *Ogden, William B.*
1879 O'Gorman, Richard.
1897 Ohman, August R.
1901 O'Leary, H. A.
1874 Olyphant, Robert M.
1875 *Opdyke, William S.*
1893 Operti, Albert.
1882 Oppenheim, Edward L.
1889 Orr, Alexander E.
1901 *Orvis, Charles E.*
1903 Osborn, Eugene E.
1901 Outerbridge, Paul.
1903 Overstreet, William I.
1896 Owen, James, C.E.
1895 *Owen, Miss Luella A.*

1898 *Paget, Almeric H.*
1901 Paige, Edward Winslow.
1897 Palmer, N. F.
1889 Palmer, Stephen S.
1899 *Parish, Edward C.*
1872 *Parish, Henry.*
1902 Parker, James H.
1886 Parris, Edward L.
1882 *Parrish, James C.*
1882 Parsons, Charles.
1882 *Parsons, Mrs. Edwin.*
1901 *Parsons, F. A.*
1897 *Parsons, George.*
1882 Parsons, John E.
1887 Parsons, William H.
1902 Paton, David.
1897 *Paton, William Agnew.*
1903 Patterson, Charles Brodie.
1901 Paulding, Gouverneur, II.
1895 Pease, Walter A.
1901 Pech, Dr. James.
1889 Peck, Charles E.
1898 *Pell, Frederick A.*
1901 Pell, Stephen H. P.
1874 Penfold, William Hall.
1898 Pennington, William.
1902 Penwarden, Charles S.
1903 Pepper, C. H.
1887 Perdicaris, Ion.
1890 *Perkins, W. H.*
1894 Perry, John G., M.D.
1901 Perry, Dr. Safford Goodwin.
1888 Perry, William A.
1891 Peters, Edward McClure.

Date of Election.

1887 Peters, Samuel T.
1903 *Peters, William Richmond.*
1903 *Pfizer, Charles.*
1901 *Phelps, John J.*
1888 Phillips, William D.
1902 *Phipps, Lawrence C.*
1887 *Phoenix, Lloyd.*
1886 *Phoenix, Phillips.*
1889 *Pickering, Edward C.*
1895 Pickhardt, Carl.
1902 Pierce, Henry Clay.
1893 Pinchot, Gifford.
1880 Pinchot, James W.
1891 Pincus, Frederick S.
1898 Piorkowski, Capt. A. E.
1903 Pitkin, Albert J.
1885 *Planten, John R.*
1893 *Platt, J. D.*
1882 Platt, Thomas C.
1876 Plum, James R.
1890 *Plumb, Edward L.*
1884 *Plush, Dr. Samuel M.*
1903 Poggenburg, Henry F.
1852 *Poor, Henry V.*
1890 Poor, Henry W.
1891 *Porter, Henry Kirke.*
1903 Porter, Russell W.
1897 Porter, William H.
1884 Post, George B.
1885 *Post, William Henry.*
1891 Pott, James.
1890 Potter, Edward Clarkson.
1898 Potter, Frederick.
1901 *Potts, Jesse W.*
1903 *Potts, Thomas.*
1891 Powel, De Veaux.
1880 Powell, Wilson M.
1899 Pratt, Wallace.
1897 Pray, Joseph M.
1903 Prentice, Augustus.
1897 Prentiss, George Lewis.
1901 Prince, J. Dyneley.
1903 Proctor, George H.
1903 Proudfit, Frank F.
1898 Pruyn, John V. L.
1886 Pryer, Charles.
1901 Purdy, J. Harsen.
1889 Putnam, George L.
1897 Putnam, Samuel.
1903 *Pyle, James Tolman.*

Date of Election.

1894 *Pyne, M. Taylor.*
1898 *Pyne, Percy R.*

1898 Quincy, Miss Mary Perkins.
1883 Quinlin, Leonard G.

1903 *Randolph, Evan.*
1882 Rathborne, Charles L.
1868 *Raven, Anton A.*
1903 *Raven, Richard M.*
1898 Rawson, Edward Stephen.
1890 Raymond, Charles H.
1886 *Raymond, R. W.*
1902 Rea, Samuel.
1901 *Rea, Thomas B.*
1903 Read, Frank B.
1902 *Ream, Norman B.*
1898 Redding, Joseph D.
1903 Reed, Charles.
1889 *Reed, J. Van D.*
1874 Reid, Whitelaw.
1901 Reiff, Josiah C.
1897 Reinhart, Joseph W.
1899 Remington, Joseph P., Ph.M.
1903 Reno, Jesse W.
1888 Renwick, Edward S.
1874 *Reynes, Jaime.*
1898 Reynolds, J. B.
1903 *Reynolds, James B.*
1882 Rhinelander, Charles E.
1881 Rhinelander, Frederick W.
1898 *Rhinelander, Miss Serena.*
1888 Rhinelander, William.
1874 Rhoades, John Harsen.
1886 *Rice, Isaac L.*
1874 *Richard, Auguste.*
1903 Richard, Edward A.
1901 Riker, John L.
1901 Riker, Samuel.
1874 Riker, William J.
1901 Rives, George Barclay.
1887 *Robb, J. Hampden.*
1903 Robin, Joseph G.
1872 *Robbins, Chandler.*
1891 Robbins, Miss Harriet L.
1889 Roberts, Wm. C., D.D.
1901 *Robertson, Julius.*
1880 *Robinson, Mrs. John A.*
1901 *Robinson, Nelson.*
1888 Robinson, William M.

Date of Election.

1903 Roe, Albert S.
1890 Roe, Major-Gen. Charles F.
1889 *Roelker, Alfred.*
1903 Roelker, William Greene.
1887 *Rogers, Archibald.*
1903 *Rogers, Robert.*
1896 Roncière, St. Croix de la.
1903 Root, William Stanton.
1868 Rose, Cornelius.
1903 Ross, Morgan R.
1876 Ross, William B.
1903 Rossiter, Clinton L.
1895 Rouse, Henry C.
1887 *Rowell, George P.*
1883 *Rowland, Thomas F.*
1897 *Rubino, Jacob.*
1897 Rusch, Henry A.
1899 Russak, Frank.
1899 Russak, Jacob.
1874 *Russell, Archibald D.*
1888 Russell, John E.
1889 Ryan, Thos. F.

1888 *Salisbury, Stephen.*
1897 Salomon, Sidney Hendricks.
1898 Salomon, William.
1901 *Sampson, Alden.*
1875 *Sandford, Elliott.*
1874 Sands, Andrew H.
1895 Sands, Robert C.
1878 *Sands, William R.*
1895 Sanford, Robert.
1886 Satterlee, F. LeRoy, M.D.
1903 *Satterlee, Herbert L.*
1903 Saul, Lester J.
1902 Sawyer, George C.
1870 *Schafer, Samuel M.*
1897 Schaus, Hermann.
1890 Schell, F. Robert.
1874 *Schermerhorn, F. Augustus.*
1890 Schernikow, Ernest.
1898 *Schieffelin, George R.*
1875 *Schiff, Jacob H.*
1902 *Schiff, Mortimer L.*
1903 Schirmer, Gustave.
1903 Schirmer, Rudolph E.
1903 Schloss, Henry W.
1885 Schmelzel, William R.
1901 Schmid, Dr. H. Ernest.
1888 *Schultze, John S.*

Date of Election.

1877 Schuyler, Philip.
1882 *Schuyler, Spencer D.*
1902 *Schwab, Charles M.*
1890 Schwarzmann, A.
1903 Scott, Edward W.
1883 Scott, Rufus L.
1895 Scudder, Moses L.
1897 See, Horace.
1887 Seligman, DeWitt J.
1901 Seligman, Isaac N.
1903 *Sellers, William.*
1887 Sellew, T. G.
1903 *Sells, Elijah W.*
1901 Senter, J. Herbert.
1902 Seward, Frederick W.
1898 Seward, George F.
1898 Seward, Gen. William H.
1893 *Sexton, Edward Bailey.*
1871 Shaler, Major Gen. Alexander.
1897 *Shardlow, Joseph.*
1903 Shaughnessy, Sir Thomas G.
1893 Shaw, Charles A.
1901 Shaw, N. Archibald, Jr.
1895 Shaw, W. M.
1897 Sheehy, W. H.
1888 Sheldon, Edwin B.
1888 *Sherman, Charles A.*
1886 *Sherman, George.*
1856 Sherman, W. Watts.
1903 Sherwood-Dunn, B.
1898 Shillaber, William, Jr.
1903 Shippy, Henry L.
1887 Shortall, John G.
1876 *Sibley, Hiram W.*
1899 Siebert, Wilbur H.
1903 *Siegel, Henry.*
1903 Siegel, Jacob.
1890 Simonson, William H.
1903 Simpson, Ernest L.
1898 Simpson, William T.
1883 *Sinclair, John.*
1901 Slade, William G.
1874 Sloan, Samuel.
1899 Smiley, Albert K.
1901 Smillie, Charles F.
1888 Smith, A. Cary.
1901 Smith, Alfred H.
1893 Smith, Benjamin E.
1901 Smith, Charles Robinson.
1890 *Smith, Sir Donald A.*

Date of Election.

1893 Smith, D. Cady.
1902 Smith, Dr. E. Fayette.
1879 *Smith, E. Reuel.*
1903 Smith, George H.
1899 Smith, J. Frailey.
1887 Smith, James Rufus.
1887 Smith, Nathaniel S.
1901 Smith, Ormond G.
1889 Smith, Philip Sherwood.
1878 Smith, S. Newton.
1883 Smith, William Alexander.
1895 Smith, W. Wheeler.
1902 Smyth, Henry Lloyd.
1888 Smythe, Rev. Hugh.
1890 Snow, Elbridge G.
1903 Snow, Fred W.
1895 Sorchan, Victor.
1883 Sorzano, Julio F.
1880 *Southwick, Henry K.*
1883 Spence, Lewis H.
1856 Spofford, Paul N.
1897 Standish, Myles.
1891 Stanton, John.
1892 Starr, Theodore B.
1901 Stebbins, George L.
1903 Steinway, Frederick T.
1888 Stephens, Benjamin.
1883 Stern, Louis.
1887 Sterry, George E.
1879 Stetson, Francis Lynde.
1887 *Stetson, George W.*
1879 *Stevens, Frederick W.*
1887 Stevens, George T., M.D.
1901 Stevenson, Edward Luther, Ph.D.
1898 Stevenson, Paul Eve.
1895 Stevenson, R. W.
1875 Stewart, Col. Charles Seaforth.
1887 Stewart, Lispenard.
1878 Stewart, William Rhinelander.
1901 *Stickney, Charles D.*
1891 Stieglitz, Edward.
1897 Stine, Marcus.
1892 Stokes, I. N. Phelps.
1884 Stokes, James.
1895 Stone, Mason A.
1883 Stone, Sumner R.
1897 Stotesbury, Louis W.
1889 Strauss, Isidor.
1903 Strauss, Frederick.
1873 Sturges, Frederick.

Date of Election.

1875 Sturges, Henry C.
1901 Sturges, William C.
1873 *Sturgis, Frank K.*
1901 Sturgis, Thomas.
1874 Stuyvesant, Robert R.
1872 *Stuyvesant, Rutherfurd.*
1891 *Suckley, Robert B.*
1887 Sutton, J. Ford, D.D.
1903 Sutton, James F.
1893 Swayne, Francis B.

1882 *Tailer, Edward N.*
1877 *Talcott, James.*
1889 Tatham, Charles.
1901 Tatlock, John, Jr.
1902 Taylor, Charles H., Jr.
1898 Taylor, Charles M., Jr.
1868 Taylor, Douglas.
1902 Taylor, F. F.
1902 Taylor, Frederick.
1895 Taylor, George.
1903 Taylor, Henry R.
1901 Taylor, Walter C.
1889 Tefft, F. Griswold.
1882 *Terry, John T.*
1876 *Terry, Rev. Roderick.*
1901 Terry, Walter Phillips.
1900 Tesla, Nikola.
1883 Thalmann, Ernest.
1891 Thaw, Benjamin.
1897 Thomas, Geo. C.
1901 Thomas, John Lloyd.
1898 Thompson, D. W.
1902 Thompson, John C.
1901 *Thompson, Lewis S.*
1898 Thompson, Walter.
1902 *Thomson, Elihu.*
1886 Thorne, Jonathan.
1890 Thorne, Samuel.
1890 Thorp, John R.
1893 *Tichenor, Francis M.*
1885 Tiffany, C. C., D.D.
1891 *Tobey, Gerard C.*
1901 Todd, Rev. William E.
1875 Toel, William.
1897 Tonnelé, Walter.
1900 Tracy, J. Evarts.
1897 Treacy, Richard S.
1888 Tresidder, John R.
1893 Trusdell, Warren N.

Date of Election.

1899 *Tucker, George F.*
1901 *Tuckerman, Alfred.*
1901 Tuckerman, Paul.
1884 Turner, J. Spencer.
1900 Turnure, George.

1888 *Uhl, Edward.*
1891 Ullmann, Emanuel S.
1891 Ulmann, Ludwig.
1902 Ulloa, G., Juan J.
1897 *Underhill, Eugene.*
1897 Untermyer, Maurice.

1890 Valentine, Ferdinand C., M.D.
1887 *Van Alen, J. J.*
1897 Van Antwerp, William C.
1901 van Beuren, F. T., Jr., M.D.
1870 *Van Brunt, Charles H.*
1875 Van Buren, John D.
1889 *Vanderbilt, George W.*
1878 *Vanderbilt, William K.*
1895 Vanderpoel, Waldron B., M.D.
1876 Van Hoesen, George M.
1900 Van Holland, Henry.
1902 *Van Rensselaer, A.*
1887 *Van Slyck, George W.*
1891 *Van Winkle, Edgar B.*
1887 Verastegui, Alberto de.
1888 Ver Planck, Wm. G.
1900 *Vetter, Dr. Charles.*
1898 Voelker, John Ph.
1901 von Briesen, Arthur.
1875 *von Post, Herman C.*
1903 von Schmid, J. O.
1899 Vorse, Albert White.
1902 Vose, Edward N.
1890 Vose, Geo. H.

1890 *Wadsworth, Herbert.*
1898 *Wadsworth, Wm. Austin.*
1898 Wait, William B.
1898 Wales, C. M.
1900 Walker, Henry Freeman, M.D.
1898 Walker, William Augustus.
1903 Wallace, William H.
1898 Warburg, Felix M.
1900 Wardwell, William T.
1898 Warner, James Harold.
1902 *Warren, Samuel D.*
1895 Warren, William R.

Date of Election.

1900 Washington, W. D'H.
1899 Waterbury, John I.
1898 *Watkinson, George.*
1879 *Watson, Francis A.*
1884 *Watson, George H.*
1876 Wedemeyer, A.J. D.
1900 Weeks, John R.
1900 *Wehrhane, Charles.*
1903 Weir, Col. John.
1895 Wells, Charles W.
1897 Wenman, James F.
1902 Wensley, Robert L.
1901 Wentz, James M.
1898 Weston, Edward.
1900 Wetherbee, Gardner.
1899 Wetherill, Henry Emerson, M.D.
1888 Wetmore, Edmund.
1874 *Wetmore, George P.*
1872 *Wetmore, William Boerum.*
1901 *Wetmore, W. S. K.*
1887 Wheelock, G. G., M.D.
1903 Wheelock, William E.
1903 White, Abraham.
1868 White, Alexander M.
1887 White, Alfred T.
1887 White, Henry.
1902 White, Henry Clay.
1886 White, Horace.
1887 *White, Julian LeRoy.*
1886 *White, S. V.*
1887 White, William Augustus.
1878 *Whitehead, Henry M.*
1901 Whitehouse, William FitzHugh, Jr.
1898 Whitfield, R. P.
1903 Whitney, Horace P.
1891 Whitney, Milton B.
1902 *Whitney, W. Beaumont.*
1873 *Wiener, Joseph, M.D.*
1902 Wilgus, William J.
1898 Wilkins, Hartwell A.
1901 *Willcox, David.*
1901 *Willets, Howard.*
1900 Willets, John T.
1895 *Willets, Robert R.*
1901 Willits, Frederick E.
1882 *Williams, David.*
1902 *Williams, John Skelton.*
1901 Williams, John T.
1901 *Williams, Timothy S.*
1893 Wills, Charles T.

Date of Election.

1903 Wilson, Henry R.
1870 *Wilson, Gen. James Grant.*
1881 Wilson, John.
1888 Winslow, Dan.
1875 Winslow, Gen. Edward F.
1901 Winslow, John Flack.
1902 Winter, Emil.
1900 *Winthrop, Grenville L.*
1888 Witherbee, Frank S.
1891 Wolcott, Henry Roger.
1897 Wolff, Emil.
1903 Wood, Henry R.
1900 Wood, Orrin S.
1903 Wood, Rufus H.
1884 Wood, William H. S.

Date of Election.

1895 Woodford, M. D.
1898 Woods, Edward A.
1898 Woods, John A.
1888 *Woodward, James T.*
1886 Wright, William Phillips.
1902 Wyckoff, Clarence F.
1902 *Wyckoff, Edward G.*
1901 Wyckoff, William F.

1891 Young, Edward L.
1895 Young, Richard N.

1884 *Zabriskie, Andrew C.*
1898 Zaring, Charles W.
1900 *Ziegler, William.*

Members and Fellows Deceased, October 27, 1899, to June 30, 1903.

Ropes, John C., October 27, 1899.
Webb, William H., October 30, 1899.
Moir, James, December 7, 1899.
Ponce de León, Néstor, December 19, 1899.
Miller, George C., January 4, 1900.
Holden, E. F., January 5, 1900.
Bissinger, Philip, January 10, 1900.
Davison, Charles A., January 18, 1900.
Fitz-Gibbon, Edward, February 12, 1900.
Bend, George H., February 15, 1900.
Aub, Albert, February 26, 1900.
Grafton, Joseph, March 4, 1900.
Tower, Maj.-Gen. Z. B., March 21, 1900.
Mali, Henry W. T., March 28, 1900.
Martin, Mahlon C., April 4, 1900.
Alling, Asa A., April 14, 1900.
Hallidie, A. S., April 25, 1900.
Huntington, Charles P., April 20, 1900.
Bernheimer, Simon, April 26, 1900.
Bishop, D. W., May 1, 1900.
Taintor, Charles M., May 5, 1900.
Schell, Robert, May 8, 1900.
Constable, James M., May 12, 1900.
Marquand, John Phillips, June 4, 1900.
Wolfe, J. Burke, June 10, 1900.
F. Wayland Fellowes, June 16, 1900.
Curtis, Benjamin L., June 16, 1900.
Steinbrügge, Edward, June 28, 1900.
Coddington, Gilbert S., July 16, 1900.
Ottiwell, John D., July 17, 1900.
Knauth, Percival, July 17, 1900.
Garland, James A., July 26, 1900.
Dunlap, Robert, August 2, 1900.
Huntington, Collis P., August 13, 1900.
Wilson, J. Wall, August 21, 1900.
Pierce, Moses, August —, 1900.
Turner, Elisha, September 14, 1900.
Sayre, Lewis A., September 21, 1900.
Ames, Caleb Tyler, September 27, 1900.
Hudson, John E., October 1, 1900.
Bixby, Robert F., October 16, 1900.
Cameron, Sir Roderick W., October 19, 1900.
Warner, Charles Dudley, October 20, 1900.
Squibb, E. R., October 26, 1900.
Stryker, Gen'l William S., October 29, 1900.
Niles, William W., October 30, 1900.
Strong, William L., November 2, 1900.
Stott, Frank N., November 4, 1900.
Dun, R. G., November 10, 1900.
Villard, Henry, November 12, 1900.
King, John A., November 21, 1900.
Bunker, Matthew, December 11, 1900.
Beaman, Charles C., December 15, 1900.
Ottendorfer, Oswald, December 15, 1900.
Meyer, F. William, December 19, 1900.
Goodridge, John C., Jr., December 27, 1900.

Hitchcock, Hiram, December 30, 1900.
Frazar, Everett, January 3, 1901.
Amy, Henry, January 11, 1901.
McCarter, Thomas N., January 11, 1901.
Peabody, Arthur J., January 13, 1901.
Morrison, Henry, January 14, 1901.
Hendricks, Clifford B., January 14, 1901.
McAlpin, David H., February 8, 1901.
Evarts, William M., February 28, 1901.
Moss, H. O., March 2, 1901.
Smith, Henry N., March 13, 1901.
James, Edward C., March 24, 1901.
Bliss, George T., March 24, 1901.
Stevens, Charles Albert, March 27, 1901.
Rice, J. M., March —, 1901.
Chaix, Prof. Paul, March 28, 1901.
Constantine, Andrew J., April 13, 1901.
Parsons, William, April 16, 1901.
Coppell, George, April 19, 1901.
Dunham, James H., April 28, 1901.
McCormick, Richard C., June 2, 1901.
Peabody, Charles A., July 3, 1901.
Scott, Julian, July 4, 1901.
Fiske, John, July 4, 1901.
Lorillard, Pierre, July 7, 1901.
Taylor, Alfred J., July 12, 1901.
Dunscomb, Richard T., July 16, 1901.
Kelly, Edward, July 27, 1901.
Arnot, Matthias C., July 31, 1901.
Nordenskiöld, Baron A. E., August 12, 1901.
Hand, Clifford A., August 18, 1901.
Owen, Mrs. Thomas J., August 21, 1901.
Robbins, S. Howland, September 4, 1901.
Armour, Herman O., September 8, 1901.
West, George, September 19, 1901.
Douglass, Andrew E., September 30, 1901.
Sturges, Edward, November 2, 1901.
Bauchle, Thomas H., December 18, 1901.
Spencer, James C., December 22, 1901.
Maunoir, Charles, December 22, 1901.
King, Clarence, December 23, 1901.
Cochran, William F., December 27, 1901.
Sewell, William J., December 27, 1901.
Laidlaw, H. B., January 8, 1902.
Bacon, Lathrop R., January 18, 1902.
Faye, James J., January 27, 1902.
Faile, Thomas H., January 26, 1902.
Compton, A. T., January 30, 1902.
Carter, Aaron, January 31, 1902.
Milliken, James, February 4, 1902.
Dufferin and Ava, Marquis of, February 12, 1902.
Bierstadt, Albert, February 18, 1902.
Tiffany, Charles L., February 18, 1902.
Marquand, Henry G., February 26, 1902.
Goodridge, Mrs. Frederic, March 3, 1902.
Doudge, James R., March 12, 1902.
Hitchcock, Henry, March 18, 1902.
Jaffray, Robert, April 12, 1902.
Coutan, Adolphe R., May 16, 1902.
Crawford, Francis, June 1, 1902.
Armstrong, George E., June 11, 1902.
Townsend, Randolph W., June 16, 1902.
Hoffman, Eugene A., June 17, 1902.
Baker, Cyrus O., July 4, 1902.
Mackay, John W., July 20, 1902.
Rexford, W. M., July 20, 1902.
Schafer, Simon, July 28, 1902.
Butler, William Allen, September 9, 1902.
Babcock, Samuel D., September 14, 1902.
Howells, Henry C., October 11, 1902.
Bennet, Ludovic, November 6, 1902.
Owens, William F., November 9, 1902.
Lewis, Enoch, November 15, 1902.
Livermore, Frank, November 18, 1902.
Chrystie, Wm. F., December 3, 1902.
Tillinghast, William H., December 9, 1902.
Adams, Charles H., December 14, 1902.
Farmer, Silas, December 28, 1902.
Irwin, William, December 31, 1902.
Schermerhorn, W. C., January 1, 1903.
Haskins, Charles W., January 9, 1903.
Marié, Peter, January 13, 1903.
Flanagan, William L., January 18, 1903.
Hewitt, Abram S., January 18, 1903.
Freeman, William C., February 7, 1903.
McCreery, James, February 26, 1903.
Turnbull, Robert J., March 2, 1903.
Johnes, Edward R., March 28, 1903.
Lawrence, John S., April 1, 1903.
Ivison, David B., April 6, 1903.
Wilson, J. B., April 22, 1903.
Du Chaillu, Paul B., April 30, 1903.
Brookfield, William, May 13, 1903.
Musgrave, Thomas B., June 1, 1903.
Hoyt, Ezra P., June 9, 1903.
Hoyt, Alfred M., June 18, 1903.

BOOK NOTICES.

Handbook of Climatology, by Dr. Julius Hann. Part I. General Climatology. Translated, with the author's permission, from the second revised and enlarged German edition, with additional references and notes, by Robert De Courcy Ward, Assistant Professor of Climatology in Harvard University. New York (The Macmillan Co.) 1903. XIV, 437 pp.

Dr. Julius Hann's Handbuch der Klimatologie has for many years been the standard text-book of the principles of climatology for teachers and advanced students. The translation, by Mr. Ward, of Harvard College, of the second edition of this great work will prove to be a welcome contribution from the press of Macmillan Company by opening up the results of the best modern research to a much larger circle of readers. The first edition appeared in 1883, in the "Library of Geographic Handbooks," published by Friedrich Ratzel, in Stuttgart, and at once took first rank as a text-book of instruction in climatology. In 1897 a second edition appeared, carefully revised and greatly enlarged. Into this book the author, Dr. Julius Hann, of the University of Vienna, has put the best fruits of a long and productive career of research and instruction. For more than thirty years Dr. Hann has been an active worker in the field of meteorology, as investigator, administrator, instructor, and editor. It is safe to predict that his handbook will continue for many years to come to afford inspiration and instruction to students interested in the climates of the globe.

The second edition comprises three volumes, with a total of about twelve hundred small octavo pages of text. The first contains the principles of climatology, discussing factors involved in climate in general—the solar climate, the principal forms of modified terrestrial climates, and the causes of climatic changes. The second and third volumes are devoted to regional or descriptive climatology, treating separately the climates of the equatorial regions, the temperate regions, and the polar regions.

In defining the scope of the Handbook the author calls attention to the difficulties encountered in attempting to draw sharp lines of distinction between climatology and meteorology. Climatology is treated in its more restricted sense as a part of meteorology—that part which deals with the sum total of the average conditions of

the atmosphere at any given place. "Meteorology, when taken in a restricted sense, seeks to explain the various atmospheric phenomena by known physical laws, and to discover the causes underlying the succession of atmospheric processes." It is impossible, however, to treat either subject satisfactorily without including much of the other. The practical difficulties of deciding how much of *meteorology* to include in his *climatology* have been largely eliminated in the present case by the author's recent publication of a "Treatise on Meteorology." These two publications are supplementary and form a comprehensive and invaluable repository of the best knowledge of atmospheric conditions and processes. The great number of references to original sources of information contained in the footnotes attest the wide reading and scholarly preparation of the author, and will greatly aid the student who may desire to go more deeply into the subjects treated than the limits of a single text-book will permit.

Only the first volume of the second edition has been translated by Mr. Ward primarily, in order that it might serve as a text-book for students in the course in general climatology in Harvard College. The great additional cost of time, labour, and expense which the two volumes on regional climatology would have involved made it impracticable to include them in the translation. The first volume is, however, complete in itself, and does not lose in value by separation from the others. The translation essentially reproduces the original, although numerous additional paragraphs are inserted in order to introduce the results of researches which have appeared since the publication of the German edition in 1898, especially such as are derived from American sources. Additional footnotes and literary references are also of frequent occurrence, adding greatly to the value of the translation. Just how much new material has been introduced into the American edition by the translator can be determined only by careful comparison with the original, as there is no distinguishing mark to separate the old from the new. According to the translator's preface, however, the author has accepted all changes and additions, thereby making them his own. The paragraph headings have been largely increased in number, facilitating reference to particular subjects.

The metric system of the original has been wisely retained in the translation, but conversion tables are added in an appendix for the convenience of readers who can think only in the cumbersome system of English weights and measures. Diagrams are few in number, but simple and effective when used at all.

The translation has been carefully done; the meaning of the original has been clearly and accurately reproduced—a task not always easy in view of the German fondness for long and involved sentences.

Mr. Ward has put into this volume much time and thought, and much labour which may be regarded as unremunerative when measured in dollars and cents, but he has made easily accessible to the American and English student and instructor the best book in the market of the principles of climatology for use in our higher institutions of learning.

It is to be hoped that Mr. Ward, or some one equally competent, will set himself the task of translating Dr. Hann's more recent work, "A Treatise on Meteorology," published in 1901 by Tauchnitz of Leipsic. This is the crowning work of a long and active life devoted to the advancement of our knowledge of the physics of the atmosphere. The volume deserves an early translalation into English and a place beside the "Handbook of Climatology." F.

Geography of Minnesota, by C. W. Hall, Professor of Geology and Mineralogy in the University of Minnesota, 299 pp. The H. W. Wilson Company, Minneapolis, 1903.

Professor Hall has made a useful book for the general reader and the high school student of Minnesota, and a valuable book of reference for teachers of geography and others who may need to find in compact form the facts of the geography of this great northwestern State. The subject is treated in a number of short chapters, with ample illustrations. Some of the larger maps, as, for example, the elevation map, opposite page 8, do not equal in quality the pictorial illustrations, and might be redrawn, to the improvement of a volume which as a whole deserves much praise.

The work is rather broadly geographic, and devotes several chapters to topics in meteorology. Then it passes to the ice invasions, springs, and ground waters and streams. The general principles of the several subjects are treated, making the book of value to untrained readers. Several excellent chapters are given to the lakes, both existing and glacial. Other topics are: prairies, forests, hills, mountains, rocks, and minerals. Thus the number of texts, describing in compact form a single State, is slowly increasing; but we must still, for most States, search through many volumes, and we have nothing to offer the inquiring reader.

A. P. B.

The Glacial Geology of New Jersey, by Rollin D. Salisbury. Volume V of the Final Report of the State Geologist. Trenton, 1902.

This volume may be taken as an illustration of the remarkable advance of glacial geology in recent years. We find 802 pages, with a generous outfit of maps and pictures descriptive of the surface formations of the northern part of a small State—formations which the earlier geologists regarded as a hindrance to their work, which now, however, are recognized as of the greatest meaning to the farmer, builder, engineer, and, indeed, to every thoughtful person. Previous volumes of the Final Report cover Topography, Climate, Magnetism, Mineralogy, Botany, Zoology, Water Supply, and Physical Geography. The geographic features of the State are therefore very broadly and fully treated with the issue of this report on the glacial geology.

A considerable section (226 pp.) is devoted to principles making it possible for a resident of New Jersey to take up the subject without a separate text-book. The principles are, however, developed with especial reference to the State concerned. No question is more common, or harder to answer, than that relating to the thickness of the ancient ice. The author gives a cautious estimate for the north line of the State, that the maximum thickness of the ice

> was somewhere between 1,500 and 2,500 feet, and its minimum between 1,000 and 1,500 feet, when the ice was at its maximum stand.

As regards the measure of glacial erosion, Professor Salisbury thinks that hills and ridges were smoothed, but without serious modifications of general configuration. It is recognized, however, that this area lies on and near the glacial boundary, where movement was less powerful and less prolonged. Exceptional erosion, in certain localities, by plucking is noted, as along the Palisades ridge, which the ice crossed to the southeastward, carrying blocks from the top of the cliff to Manhattan, Staten, and Long Islands.

The thickness—or thinness, perhaps, we should say—of the drift points to moderate glacial erosion. Twenty or twenty-five feet is the minimum, and forty or fifty feet a possible maximum thickness, even including the moraine belt. New Jersey was not without its temporary or glacial lakes; and the history of "Lake Passaic" was given several years ago by Dr. H. B. Kümmel, the present State Geologist. This history is repeated in this volume. The section on general principles closes with a history of the glacial period. Part 2, including the rest of the volume, is devoted to

local details. These are presented under the following heads: the Terminal Moraine; the Drift of the Appalachian Province; the Drift of the Highlands; the Drift of the Triassic Plain; Stratified Drift of Late Glacial Age South of the Moraine; and Extra-Morainic Glacial Drift. This extra-morainic drift is referred, doubtfully, to the Kansas epoch. A pocket at the end of the volume contains several maps, among them one showing the direction of glacial movements and one giving the distribution of the glacial drift. A. P. B.

The New York City Folio, of the Geologic Atlas of the United States. U. S. Geological Survey, Folio No. 83. Washington, D. C., 1902.

This folio includes the Paterson, Harlem, Staten Island, and Brooklyn quadrangles of New York and New Jersey, containing more people than any similar area in the New World, the population by the last census being 4,560,800. In plan the work is similar to other Survey Folios giving geological history and resulting geographic features and resources. As with the others, the inside cover pages contain a copious explanation, a kind of key to the terminology and the elaborate maps which are used.

The general geography is described by Richard E. Dodge and Bailey Willis. The drainage features are given in detail in connection with a map, which also shows depths to ten fathoms by contour lines. The geology is given in a series of papers by several authors. The outline of geologic history is by Bailey Willis, and is followed by more detailed accounts of the formation and of the periods to which they belong. Dr. F. J. H. Merrill describes the metamorphic crystalline rocks. Of these the chief representatives are: the Fordham Gneiss, which is pre-Cambrian; the Poughquag Quartzite, which is Cambrian; the Stockbridge Dolomite, a Silurian formation continuing from Western New England; and the Hudson Schist, equivalent to the Berkshire Schist of New England. Various younger rocks are igneous in character, and occur as intrusives in those named above. The Stockbridge Dolomite furnishes the marble of Tuckahoe, and, by the ease of its erosion, has determined along its belts the existence of the now submerged valleys which have made New York what it is.

A much more detailed paper is by Mr. N. H. Darton, and deals with the Jura-Trias, here known as the Newark Group, consisting of reddish brown shales and sandstones, and having, in association

with its strata, those sheets of volcanic rock which form the Palisades of the Hudson and the Watchung or Orange Mountains. Even the non-geological reader of the Folio will find Mr. Darton's Fig. 3 of much interest, as it shows the relations of the sandstones and the lava masses, from the gneiss, on the east of the Hudson, westward, to the gneiss of the New Jersey Highlands beyond Orange. We have the sedimentary rocks dipping westward with the Palisades trap, the Snake Hill trap, and the first, second, and third Watchung traps, in order, going westward. Below the geologic section is drawn a true profile of the surface, without vertical exaggeration, and the two taken together are fitted to give the reader true and permanent information. The Watchung lava sheets and the Palisades are described in sufficient detail to make the Folio of much value as a local guide. The Palisades are formed by the intrusion of a single sheet, which at some points is known to have been 1,000 and more feet in thickness.

Mr. Willis and Dr. Arthur Hollick give short sketches of later geologic events, which, however, have left small records in this immediate field, until we reach the Pleistocene formations, which are described at length by Professor R. D. Salisbury, from his studies in connection with the Geological Survey of New Jersey.

An introductory statement of general principles is given, which will aid the general reader, and the local description begins with a map showing the direction of glacial movements and the course of the terminal moraine. The latter crosses New Jersey by Morristown and Perth Amboy, and then swings to the northwest across Staten Island, and begins its long extension, by Brooklyn and Jamaica, through Long Island. The drift is usually thin, outside of the morainic belts, and glacial scratches and mouldings of the rocks are frequent, especially east of the Hudson River and north of East River and the Sound, as at many points in Central Park. The post-glacial changes are moderate in amount, and consist of stream and shore erosion, weathering of the glacial drift, the blowing of sand, accumulation of sand by waves, and the growth of beds of peat.

A short section by Bailey Willis and R. E. Dodge is devoted to physiographic features, including the origin of New York Harbour, the development of shore features, the relations of valleys and of heights, and the water and wind gaps. The development of valleys on the dolomite, referred to by Dr. Merrill, is here more fully treated. The effects of physiographic features on culture are briefly treated, and the text closes with an account of the water

supply of New York City, by Henry A. Pressey. The four quadrangles are shown in contoured maps, while a second set gives the historical geology, and a third the surficial geology. There is a structural map of the Harlem quadrangle, and two illustrative sheets reproduce views of the Palisades, the Watchung traps, the Falls of the Passaic River at Paterson, the terminal moraine on Staten Island, and glaciated rock surfaces in Bronx Park. The Folio is the best guide to the geology of the region, while its inconvenient size finds ample compensation in the elaborate maps which compel the use of the folio form. A. P. B.

The Tanganyika Problem. An Account of the Researches undertaken concerning the Existence of Marine Animals in Central Africa. By J. E. S. Moore, F.R.G.S. London: Hurst & Blackett, Ltd., 1903.

This book is the result of Mr. Moore's two expeditions to the lake region of Central Africa especially to study the occurrence of animals of a distinctly marine type in Lake Tanganyika, and the problem of a former connection between the sea and the lake by which the animals were originally introduced. The volume, being thus devoted to the consideration of animal life in the lakes and of the ancient physiography of Central Africa, is almost wholly biological and geological; it is geographical, however, so far as it deals with the present distribution of animal life and with the former physical geography of Africa. The value to zoology of the studies undertaken is evident from the fact that nearly 200 entirely new animal types were discovered; and the book is the only one containing an extended illustrated account of the animals found in the great African lakes. The difficulty of accounting for the existence of the marine types in Tanganyika is increased by the fact that none of them is found in the other central lakes from Rudolf to Bangweolo and Nyasa. The absence of these shells from the other lakes is opposed to the theory that the marine types reached Tanganyika through the Red Sea or the Indian Ocean; and Mr. Moore's geological studies incline him to the view that they may have inhabited a Jurassic sea which is supposed to have extended over a large portion of the Congo basin, a part of it occupying the Tanganyika area. Some of Mr. Moore's hypotheses are not fully accepted either by biologists or geologists; but all will admit the thoroughness of his investigation of the Tanganyika fauna, the great merit of his descriptions and illustrations

of the animals found, and the considerable additions to geological knowledge of the region of the central lakes, to which his colleague, Mr. Fergusson, especially contributed.

The Scope of Geographic Investigation in Lakes (Die Aufgabe Geographischer Forschung an Seen). By Prof. Dr. Willi Ule, Privatdocent in the University of Halle.*

Limnology, the science of lakes, starting as a branch of geography, has of late developed into an independent science, drawing upon quite a number of sciences. It is time to define the principles according to which its problems are to be included in or excluded from geography.

Forel's classification of limnology exceeds the geographic scope, since he divides it into hydrography, geology, petrography, hydrology, climatology, chemistry, thermics, optics, and biology. Ule, laying stress on the geographic point of view, makes the following classifications:

1. General geographic conditions.
2. Morphology and geology of lakes.
3. Physical conditions of the water.
4. Chemical composition of the water and of its deposits.
5. Biologic conditions.
6. Anthropogeographic significance of lakes.

To illustrate the distinction, he observes that the investigation of the thermic conditions is mainly a physical or limnologic problem, while the explanation of the differences in temperature among lakes is mainly the task of the geographer. He proceeds to enumerate the geographic problems under each of the six headings of his classification.

1. (*a*) First among *general geographic conditions* is the description of the location, shape, and size of lakes. These suggest classifications (lakes of coasts, river lowlands, folded areas, fractured areas, volcanic, glacial, and drainless regions). (*b*) Description of the tributary basin, including supply and drainage, and involving a discussion of the climatology. (*c*) Budget of the lake, that is, relation between inflow and outflow. (*d*) Height of water, including oscillations, which, by comparison with record of precipitation, show whether the lake is fed mainly by surface water or by ground

* From Abhandlungen der K. K. Geographischen Gesellschaft in Wien, IV Band, 1902, No. 6. Wien, 1902.

water. (*e*) The mode of feeding suggests a new classification (rain-fed, groundwater-fed, spring-fed, river-fed, glacier-fed). (*f*) Influence of lakes on climate, which may throw light on anthropogeographic and phytogeographic problems. The freezing of lakes is a geographic problem, because dependent on location, and because its duration influences human conditions. The cause of freezing and its physical mechanism, on the other hand, belong to the province of the limnologist.

2. (*a*) First among problems of *morphology and geology* is the comparison of the shape of the lake basin with the surrounding orography. Was the lake created by the same process as the rest of the land surface, or subsequently? Different classes of land are wont to be characterized by different types of lake basins. Thus, in the arid regions, lakes, as a rule, are quite shallow; if deep lakes occur there, they are of different origin. (*b*) The shape of the lake basin is determined by its mode of origin. A trough-like form indicates glacial origin. Dammed river valleys show the marks of running water. (*c*) From soundings the mean depth and the relation of this and of the greatest depth to the area of the lake may be calculated. (*d*) Influence of the geologic age and structure of the country rock. (*e*) Influence of recent processes, such as changes in shores and fillings of the basin, often suggesting explanations of earlier processes. The transformation of the shores is the effect of wave-beat, wind and rain. Do these work in the same or in opposite directions? Do they vary with the height of water? The filling with sediment is partly eolian and partly river-borne—the former prevailing in arid, the latter in humid countries. Annual measurements of deposits show rate of filling. Delta formation is governed by mud-carrying capacity of rivers and by oscillations of lake level. From volume of deposits and rate of deposition the age of some alpine lakes, beginning with the close of the glacial period, has been calculated at 16,000 to 32,000 years. (*f*) Morphologic and geologic conditions often serve to explain the origin of the lake. This is eminently a geographic problem, since many types of lakes are confined to certain strongly-marked geographic provinces. (*g*) The mode of origin suggests another classification. Ule makes the division into primary and secondary lakes, each being subdivided according to the nature of the lake-creating forces.

3. As regards the *physical conditions of the water*, it is more difficult to define the province of geography. The physical conditions are static and dynamic, thermic, optic, and acoustic.

STATICS AND DYNAMICS.—Certain deformations of lake level may be due to attraction by land masses. The phenomenon of *seiches* has been observed in nearly all large lakes. Is it influenced by geographic location or climate or by the condition of the atmosphere? The wave-beat determines the action on the shore and influences navigation. Currents have been observed in some lakes.

THERMICS.—Hardly any two lakes show the same temperature record. It is the geographer's task to study the variations by comparison with geographic location. Sometimes thermic peculiarities are due solely to local surroundings. The relations between water temperature and air temperature, and between temperature and evaporation, furnish subjects of inquiry.

OPTICS.—Many lakes, geographically alike, show the same colour, though considerably different in physical constitution. The North German lakes, as a rule, are less transparent than the Alpine lakes. Is this due to different geographic conditions?

ACOUSTICS.—The so-called air-puffs, peculiar detonations heard at the seashore and on lakeshores, can only be explained when their geographic distribution shall have been ascertained.

4. As regards the *chemical composition*, the geographer is called upon to study it with reference to the surroundings. Artificial colouring enables the course of subterranean water to be traced. What becomes of the substances, in suspension or solution, contributed by rivers? Is their transformation dependent on geographic conditions? Passarge found that a large part of the meadow-lime deposits originated from vegetal mud in lakes subsequently filled. Comparison of results from different lakes would show any existing influence of geographic factors.

5. The importance of *biologic conditions* is illustrated by Samter's discovery, in Madü lake, of marine crustaceans that are to be regarded as relicts of the glacial period. To what extent can marine animals adapt themselves to fresh water? While the limnologist investigates the organic world of lakes, the geographer has to inquire into its origin and its significance for the lake phenomenon. At times the flora or fauna may furnish hints as to the age of a lake.

6. The *anthropogeographic significance* of lakes is evident. They furnish drink and food, and are often surrounded by fertile lowlands, thus inviting settlement. They are, probably, favoured as regards climate. They interrupt commerce by land, aid it by navigation, attract it by the settlements along their shores. Where they

freeze in winter, travel is transformed. They are apt to serve as gathering-points for the commerce of the tributary valleys. They furnish power. Finally, they are regulators of outflow, dominating the valleys below.

Prof. Ule's paper must be regarded as a suggestive contribution to the irksome but unavoidable task of drawing sharp lines where none exist in nature. If we define geography simply as the science of the earth, it manifestly embraces all the sciences, including law and theology. If we exclude from it everything that belongs to another science, there will be no geography left. Hence, if we are to have a science of geography, we must add to the generic term "science of the earth" some specific point of view from which the earth is regarded. Ritter's definition of geography as "the science of the relation between earth and man" seems to be most in favour. Ule, in his closing remarks, defines the scope of modern geography to be "the investigation of the reciprocal effects of the several phenomena of a country, and their causal connection." It may be questioned whether either definition will enable us in any particular case to say: This belongs to geography; or, This does not belong to geography. However, since this specialization is the order of the day, there is no doubt that in the future the debatable ground between geography and other sciences will bear an ever-lessening proportion to the well-recognized field covered by the definition of geography, whatever that definition may eventually be. The present work is clearly a step in that direction. R. S.

Unknown Mexico. A Record of Five Years' Exploration among the Tribes of the Western Sierra Madre; in the Tierra Caliente of Tepic and Jalisco; and among the Tarascos of Michoacan. By Carl Lumholtz, M.A., Member of the Society of Sciences of Norway; Associé Étranger de la Société d'Anthropologie de Paris; Author of "Among Cannibals," etc. Illustrated. New York, Charles Scribner's Sons, 1902. 2 vols. 8vo.

Mr. Lumholtz describes in these volumes the results of four journeys in the Western Sierra Madre—the first in 1890–91, the second in 1892–93, the third in 1894–97, and the fourth in 1898, with Dr. A. Hrdlicka.

It was a happy inspiration that led him to seek among the tribes inhabiting this great range the beliefs and manners and practices which have survived the Conquest, and the ethnologist will be

grateful for the equally happy chance which brought these practically unknown peoples under the observation of a scientific mind, before it was too late. Mr. Lumholtz lived for a year and a half among the Tarahumares and for ten months among the Coras and the Huichols, learning their languages and gradually winning the confidence which they are slow to repose in the white man; he studied also the Tepehuanes, the Tepecanos, the Nahuas, and the Tarascos. All, even the four tribes of the Sierra Madre, understand Spanish, and must in no long time be absorbed by the invading Mexican civilization. The type is precious to the student of manners; but Nature is willing that all shall go, to be lost in the civilizations that rise and fall.

Life passes quietly enough in the Sierra Madre. The Tarahumare rises and retires with the sun. In the morning he sits near the fire till his wife brings his breakfast of *pinole* (parched corn, ground and mixed with sugar and water) and roasted mice, from the traps set in the fields. The man takes his bow and arrows, or his axe, and goes hunting; the woman spends the day grinding corn, or weaving, or keeping house, like a Roman matron. When the man comes home with game he carries it under his blanket, lest a neighbour, seeing it, may expect an invitation to dinner. When not engaged abroad, the man busies himself making a bow or arrows, or playing on his home-made violin or guitar.

These Indians are not hospitable, though polite. The manner of paying visits is peculiar, and calculated to stir the envy of those who live in cities. Good manners require that the visitor shall stop twenty or thirty yards from his friend's house, with his face turned away from it. There he stays for an hour or two and then retires, if not invited in by the master of the house.

Among the most curious practices of the Indians is the *híkuli* cult, common to the Tarahumares and the Huichols, though these tribes are separated by hundreds of miles. The híkuli is a cactus (*Lophophora Williamsii* and *Lophophora Williamsii*, var. *Lewinii*), known in the United States by the name of *mescal button*. The plant lives for months after it has been rooted up, and the eating of it causes a state of ecstasy. It is regarded as a demi-god, and worshipped.

Mr. Lumholtz found that the híkuli produced exhilaration and allayed hunger and thirst. It does away with exhaustion and supplies energy, resembling in this respect the Peruvian coca; but, unlike the coca, it leaves a feeling of depression and a headache. It also produces colour-visions.

It is among the Huichols that the híkuli worship has attained the greatest elaboration, as one expression of the religious feeling for which they are remarkable. Their food supply depends upon rain, and all their prayers are, first for rain and then for health, luck, and long life. Their religion, though a form of shamanism, appears to have something in common with more advanced developments.

This most interesting and instructive work is illustrated by more than 400 reproductions of photographs of scenery and persons, as well as of objects collected by Mr. Lumholtz and deposited in the American Museum of Natural History. Mention must also be made of the map of the Sierra, undoubtedly the best as yet within reach; and it must be noted that the Spanish words and phrases, frequently incorrect, were not read in proof by the author.

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